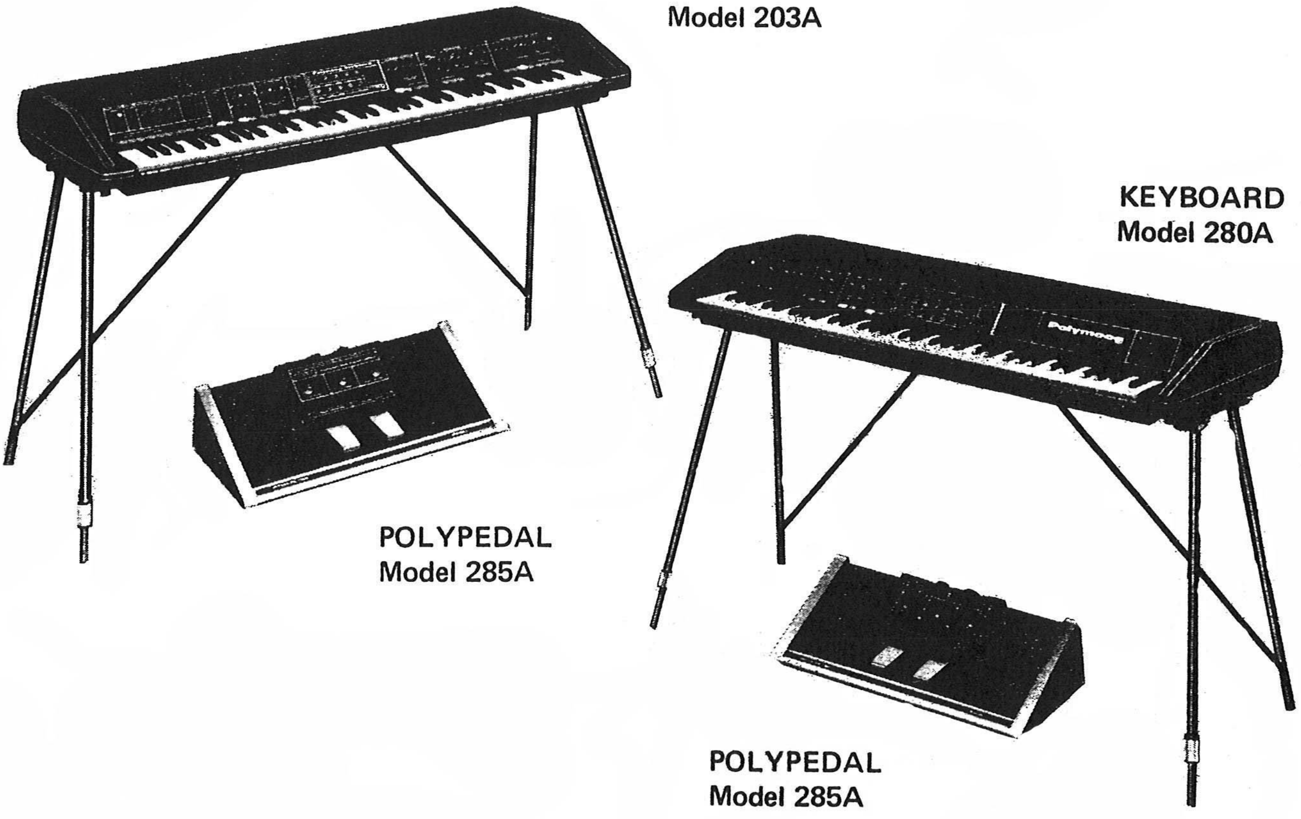
VOLUME I

MANUAL NO. 993-042314-004

TECHNICAL SERVICE MANUAL for

moog®

POLYMOOG SYNTHESIZER AND KEYBOARD



SYNTHESIZER
Model 203A

KEYBOARD
Model 280A

POLYPEDAL
Model 285A

POLYPEDAL
Model 285A

CONTENTS

SECTION PAGE NO.

POLYMOOG SYNTHESIZER SPECIFICATIONS x

POLYMOOG KEYBOARD SPECIFICATIONS xii

1 GENERAL 1-1
- 1.1 INTRODUCTION 1-1
- 1.2 PRINTED CIRCUIT BOARD ABBREVIATIONS 1-1
- 1.3 CONNECTOR NOMENCLATURE 1-3
- 1.4 GENERAL 1-10
- 1.5 POWER SUPPLY 1-10
- 1.6 FRONT PANEL CONTROL ASSEMBLY 1-12
- 1.7 CONTROL CIRCUITRY 1-13
- 1.8 MODULATOR/GENERATOR 1-16
- 1.9 FILTERING AND OUTPUT SECTIONS 1-17
- 1.10 OSCILLATOR RANKS 1-19
- 1.11 POLYMOOG AND POLYMOOG KEYBOARD PRELIMINARY CHECK ... 1-19
- 1.12 DISASSEMBLY 1-19
- 1.13 VISUAL INSPECTION 1-20
- 1.14 POLYMOOG AND POLYMOOG KEYBOARD TEST, TROUBLESHOOTING AND ADJUSTMENT 1-22
- 1.15 TEST EQUIPMENT 1-22
- 1.16 TROUBLESHOOTING 1-22
- 1.17 KEYBOARD GENERAL SERVICING 1-36
- 1.18 REMOVAL 1-36
- 1.19 TROUBLESHOOTING 1-36
- 1.20 POLYMOOG AND POLYMOOG KEYBOARD LEVELING PROCEDURE ... 1-36
- 1.21 EXTERNAL SYNTHESIZER COUPLING 1-39
- 1.22 CONTROL VOLTAGE ADJUSTMENTS 1-39
- 1.23 CONTROL VOLTAGE ALIGNMENT 1-40
- 1.24 REAR PANEL CIRCUIT DESCRIPTION AND TROUBLESHOOTING 1-42
- 1.25 FRONT PANEL SUBASSEMBLIES 1-42
- 1.26 GENERAL SERVICING POLYMOOG AND POLYMOOG KEYBOARD ... 1-42
- 1.27 FRONT PANEL DISASSEMBLY 1-43
- 1.28 RIBBON PITCH CONTROLLER REMOVAL 1-43
- 1.29 TROUBLESHOOTING 1-43
- 1.30 POLYPEDAL 1-46
- 1.31 POLYPEDAL DISASSEMBLY PROCEDURE 1-47

2 BOARDS 1, 2, 3 DIVIDER AND HIGH FREQUENCY OSCILLATORS. 2-1
- 2.1 CIRCUIT DESCRIPTION 2-1
- 2.2 GENERAL SERVICING 2-2
- 2.3 REMOVAL 2-2
- 2.4 TROUBLESHOOTING 2-2

CONTENTS (Continued)

SECTION PAGE NO.

3 BOARDS 4, 5, 6 MOTHER BOARDS, MODULATOR AND BALANCE BOARDS 3-1
3.1 CIRCUIT DESCRIPTION 3-1
3.2 GENERAL SERVICING 3-2
3.3 REMOVAL 3-3
3.4 TROUBLESHOOTING 3-3

4 BOARD 7 REFERENCE AND MODULATION OSCILLATOR, WAVESHAPE AND KEYBOARD CONTROL - TL 4-1
4.1 CIRCUIT DESCRIPTION 4-1
4.2 GENERAL SERVICING 4-6
4.3 ALIGNMENT 4-6
4.4 POLYMOOG TUNING AND ADJUSTMENT 4-6
4.5 POLYMOOG KEYBOARD TUNING AND ADJUSTMENT 4-10
4.6 REMOVAL 4-12
4.7 TROUBLESHOOTING 4-12

5 BOARDS 8 AND 14 FIXED AND VARIABLE RESONANT FILTERS AND VOX HUMANA - TC 5-1
5.1 CIRCUIT DESCRIPTION - POLYMOOG 5-1
5.2 GENERAL SERVICING 5-2
5.3 ALIGNMENT 5-4
5.4 REMOVAL 5-4
5.5 TROUBLESHOOTING 5-4
5.6 POLYMOOG KEYBOARD AUDIO CIRCUIT DESCRIPTION TC BOARD 8 5-11
5.7 FILTER BOARD 1 5-14
5.8 POLYMOOG KEYBOARD VOX HUMANA FILTER BOARD 14 5-15
5.9 AUDIO CIRCUIT ALIGNMENT 5-15
5.10 KEYBOARD DISASSEMBLY 5-16
5.11 TROUBLESHOOTING 5-16

6 BOARD 9 POLYMOOG VOLTAGE CONTROLLED FILTER AND KEYBOARD CIRCUIT AND POLYMOOG KEYBOARD PROGRAM CONTROL - TR 6-1
6.1 CIRCUIT DESCRIPTION - POLYMOOG 6-1
6.2 GENERAL SERVICING 6-7
6.3 ALIGNMENT - POLYMOOG 6-7
6.4 REMOVAL 6-10
6.5 TROUBLESHOOTING 6-10
6.6 POLYMOOG KEYBOARD PROGRAM CONTROL CIRCUIT DESCRIPTION (BOARD 9) 6-16
6.7 MODULATION RATE PROGRAMMING 6-17
6.8 MODULATION AMOUNT PROGRAMMING 6-17

CONTENTS (Continued)

SECTION **PAGE NO.**

6.9 LOUDNESS ATTACK PROGRAMMING 6-19
6.10 FOOT SUSTAIN PROGRAMMING 6-19
6.11 MISCELLANEOUS PROGRAMMING 6-19
6.12 TRIGGER CIRCUIT 6-19
6.13 KEYBOARD CIRCUIT 6-20
6.14 FILTER CONTOUR GENERATOR 6-21
6.15 TROUBLESHOOTING 6-22

7 BOARDS 10, 11, 12 LEFT HAND CONTROL, RIGHT HAND CONTROL, MODE SELECTOR, AND MASTER VOICE SELECTOR – CL AND CR 7-1
7.1 LEFT HAND CONTROL PANEL CIRCUIT DESCRIPTION (BOARD 10) – POLYMOOG 7-1
7.2 LEFT HAND CONTROL PANEL ASSEMBLY ALIGNMENT 7-3
7.3 TROUBLESHOOTING 7-3
7.4 POLYMOOG KEYBOARD LEFT HAND CONTROL BOARD CIRCUIT DESCRIPTION (BOARD 10) 7-7
7.5 TROUBLESHOOTING 7-7
7.6 RIGHT HAND CONTROL AND MASTER PRESET ASSEMBLY CIRCUIT DESCRIPTION (BOARD 11) – POLYMOOG 7-9
7.7 RIGHT HAND CONTROL AND MASTER PRESET ASSEMBLY ALIGNMENT 7-11
7.8 TROUBLESHOOTING 7-11
7.9 POLYMOOG MODE SELECTOR CONTROL CIRCUIT DESCRIPTION (BOARD 12) 7-16
7.10 MODE SELECTOR CONTROL BOARD REMOVAL 7-17
7.11 POLYMOOG KEYBOARD MASTER VOICE SELECTOR (BOARD 12) 7-17

8 BOARD 13 POWER SUPPLY 8-1
8.1 POWER SUPPLY SUBASSEMBLY CIRCUIT DESCRIPTION – IDENTIFIED WITH MOOG LOGO ON PRINTED CIRCUIT BOARD 8-1
8.2 POWER SUPPLY SUBASSEMBLY CIRCUIT DESCRIPTION – IDENTIFIED WITH FARATRON LOGO 8-2
8.3 POWER SUPPLY SUBASSEMBLY GENERAL SERVICING AND ADJUSTMENT 8-3
8.4 POWER SUPPLY SUBASSEMBLY REMOVAL 8-3
8.5 POWER SUPPLY SUBASSEMBLY TROUBLESHOOTING 8-4

LIST OF ILLUSTRATIONS

FIGURE — PAGE NO.

1-1 Connector Identification System 1-3
1-2 Polymoog and Polymoog Keyboard Simplified Block Diagram. 1-11
1-3 Typical Control Board Sequence 1-12
1-4 Typical Flow for Rectangular Rank Oscillator on Top Left Board No. 7 . . 1-14
1-5 Polymoog Printed Circuit Board Location 1-20
1-6 Polymoog Keyboard Printed Circuit Board Location 1-21
1-7 Polymoog Controls and Indicators 1-34
1-8 Polymoog Keyboard Controls and Indicators 1-35
1-9 Rear Panel 1-39
1-10 Keyboard 1-39
1-11 Voltage Controlled Filter and Keyboard Printed Circuit Board Assembly (Top Right Board) 1-41
1-12 Polypedal 1-48
4-1 Polymoog and Polymoog Keyboard Control Circuits 4-5
4-2 Reference and Modulation Oscillator Waveshape and Keyboard Control Printed Circuit Board Assembly 4-9
5-1 Polymoog Frequency Response of Filter Boards No. 1 thru 8 (TC Board 8). 5-3
5-2 Polymoog Keyboard Frequency Response of Filters 1 thru 14 and Bass Filter 5-12
6-1 Keyboard Circuit Simplified Diagram 6-5
6-2 Voltage Controlled Filter and Keyboard Circuit Printed Circuit Board Assembly 6-9
8-1 Moog Voltage Regulator Integrated Circuit 8-2
8-2 Voltage Regulator Integrated Circuit – Faratron Supply 8-3
8-3 Power Supply Assembly Adjustment Controls and Outputs. 8-4

LIST OF TABLES

TABLE — PAGE NO.

1-1 Printed Circuit Board Abbreviations. 1-1
1-2 Interconnection Abbreviations. 1-3
1-3 Polymoog Operating Controls and Indicators 1-23
1-4 Polymoog and Polymoog Keyboard Troubleshooting Chart. 1-30
1-5 Polymoog Keyboard Operating Controls and Indicators 1-31
1-6 Keyboard Assembly Replacement Parts List 1-37
1-7 General Mechanical Replacement Parts List. 1-38
1-8 Polymoog Various Keyboard Modes 1-40
1-9 Polymoog Front Panel Subassembly Replacement Parts List 1-44
1-10 Polymoog Keyboard Front Panel Subassembly Replacement Parts List 1-45
2-1 Polymoog and Polymoog Keyboard Divider and High Frequency Oscillator Board Troubleshooting. 2-3
2-2 Divider Printed Circuit Board Assembly Replacement Parts List 2-3

LIST OF TABLES (Continued)

TABLE — PAGE NO.

2-3 High Frequency Oscillator Printed Circuit Board Assembly Replacement Parts List (Version 1) 2-3
2-4 High Frequency Oscillator Printed Circuit Board Assembly Replacement Parts List (Version 2) 2-4
3-1 Mother Board Troubleshooting 3-3
3-2 Low Mother Printed Circuit MBL Board 4 Assembly Replacement Parts List 3-4
3-3 Medium Mother Printed Circuit MBM Board 5 Assembly Replacement Parts List 3-6
3-4 High Mother Printed Circuit MBH Board 6 Assembly Replacement Parts List 3-8
3-5 Modulator Printed Circuit MOD_n Board Assembly Replacement Parts List 3-9
3-6 Balance Printed Circuit BAL Board Assembly Replacement Parts List 3-10
3-7 Bypass Filter Printed Circuit BY Board Assembly Replacement Parts List 3-10
4-1 Polymoog and Polymoog Keyboard TL Board 7 Troubleshooting. 4-12
4-2 Reference and Modulation Oscillator Waveshape and Keyboard Control Printed Circuit TL Board 7 Assembly Replacement Parts List 4-14
5-1 Polymoog TC Board 8 Troubleshooting. 5-4
5-2 Polymoog Fixed and Variable Resonant Filters Printed Circuit TC Board 8 Assembly Replacement Parts List 5-5
5-3 Polymoog String Filter Board No. 1 Printed Circuit TC Board 8 Assembly Replacement Parts List (Version 1) 5-6
5-4 Polymoog String Filter Board No. 1 Printed Circuit TC Board 8 Assembly Replacement Parts List (Version 2) 5-7
5-5 Polymoog Piano Filter Board No. 2 Printed Circuit TC Board 8 Assembly Replacement Parts List 5-7
5-6 Polymoog Organ Filter Board No. 3 Printed Circuit TC Board 8 Assembly Replacement Parts List 5-8
5-7 Polymoog Harpsichord Filter Board No. 4 Printed Circuit TC Board 8 Assembly Replacement Parts List 5-8
5-8 Polymoog Funk Filter Board No. 5 Printed Circuit TC Board 8 Assembly Replacement Parts List 5-9
5-9 Polymoog Clavinet Filter Board No. 6 Printed Circuit TC Board 8 Assembly Replacement Parts List 5-9
5-10 Polymoog Vibes Filter Board No. 7 Printed Circuit TC Board 8 Assembly Replacement Parts List 5-10
5-11 Polymoog Brass Filter Board No. 8 Printed Circuit TC Board 8 Assembly Replacement Parts List (Version 1) 5-10
5-12 Polymoog Brass Filter Board No. 8 Printed Circuit TC Board 8 Assembly Replacement Parts List (Version 2) 5-11

LIST OF TABLES (Continued)

TABLE PAGE NO.

5-13 Polymoog Keyboard Audio TC Board 8 Troubleshooting 5-16
5-14 Polymoog Keyboard Audio Circuit Printed Circuit TC Board 8 Asssembly Replacement Parts List 5-17
5-15 Polymoog Keyboard Filter Board No. 1 Printed Circuit TC Board 8 Assembly Replacement Parts List. 5-18
5-16 Polymoog Keyboard Filter Board No. 2 Printed Circuit TC Board 8 Assembly Replacement Parts List. 5-19
5-17 Polymoog Keyboard Vox Humana Filter Printed Circuit Board 14 Assembly Replacement Parts List 5-20
6-1 Polymoog Voltage Controlled Filter TR Board 9 Troubleshooting 6-10
6-2 Polymoog Voltage Controlled Filter and Keyboard Circuit Printed Circuit TR Board 9 Assembly Replacement Parts List 6-12
6-3 Modulation 6-18
6-4 Polymoog Keyboard Program Control TR Board 9 Troubleshooting 6-22
6-5 Polymoog Keyboard Program Control Printed Circuit TR Board 9 Assembly Replacement Parts List. 6-24
7-1 Polymoog Left Hand Control CL Board 10 Troubleshooting 7-3
7-2 Polymoog Left Hand Control Panel Printed Circuit CL Board 10 Assembly Replacement Parts List. 7-5
7-3 Polymoog Keyboard Left Hand Control Panel CL Board 10 Troubleshooting 7-7
7-4 Polymoog Keyboard Left Hand Control Panel Printed Circuit CL Board 10 Assembly Replacement Parts List 7-8
7-5 Polymoog Right Hand Control CR Board 11 Troubleshooting. 7-12
7-6 Polymoog Right Hand Control and Master Preset Printed Circuit CR Board 11 Assembly Replacement Parts List. 7-14
7-7 Polymoog Mode Selector Panel Printed Circuit CR Board 12 Assembly Replacement Parts List. 7-17
7-8 Truth Table 7-18
7-9 Polymoog Keyboard Master Voice Selector Printed Circuit Mode Board 12 Assembly Replacement Parts List 7-20
8-1 Polymoog and Polymoog Keyboard Power Supply Voltage Adjustment and Troubleshooting 8-5
8-2 Moog Power Supply Subassembly Troubleshooting 8-6
8-3 Faratron Power Supply Subassembly Troubleshooting 8-7
8-4 Polymoog Rear Panel Subassembly Replacement Parts List 8-8
8-5 Polymoog Power Supply Replacement Parts List 8-9
8-6 Moog Power Supply Printed Circuit PS Board 13 Assembly Replacement Parts List. 8-10
8-7 Faratron Power Supply Printed Circuit PS Board 13 Assembly Replacement Parts List. 8-11
8-8 Faratron Rear Panel Subassembly Replacement Parts List 8-12

POLYMOOG SYNTHESIZER SPECIFICATIONS

SOUND SOURCES

No. of Oscillators	2 (71-pitch ranks; slaved to precision VCO)
Articulators	142 (VCA and VCF for each key)
Frequency Range	E_1-D_7, 71 note keyboard: pitch ribbon and external frequency control give maximum of ± 1 octave pitch control
Pitch Stability	± 0.2% (± 1/3 cent)
Pitch Ribbon Range	± 7 semitones minimum, ± 11 semitones maximum
Fine Tune Range	± 1 semitone
Beat Tune Range	± 1/4 semitone
Sawtooth Rank Tune	± a Major sixth
Sawtooth Rank Footage	4′ and 8′
Rectangular Rank Footage	8′ and 16′
Waveshape Select	Sawtooth, rectangular or both. Switchable for upper or lower keyboard or both

VOICES

Number	8 programmed, 1 variable
Voice Modification Controls	Sections switchable from preset to variable individually; Sawtooth rank tune, Sawtooth FM Rectangular FM/PM, Rectangular shape 1, mod, Sawtooth mix, Loudness contour, Resonators, VCF
Master Gain Controls	AUX, DIRECT, MODE RES, VCF

VOICES (Continued)

DIRECT	Direct channel output, 600 Ohms, 0dBm
RES	Resonator output channel 600 Ohms, 0dBm
Accessories	± 15V, +5 VDC power for accessories

CONTROL INPUTS

S-TRIG	Indicates filter control cycle
SWELL	Voltage control output level of BAL MIX or MIX output, 5 volts for 30dB change
FILTER	Voltage control of VCF cutoff frequency, 0.64V per octave
MOD AMOUNT	Voltage control of modulation frequency and pulse width when appropriate front panel controls are in variable mode, 0 to 5V
PITCH	Voltage control of oscillator frequency. Tip of jack controls both oscillators simultaneously. Stereo ring controls the frequency of rectangular rank separately 0.9V/octave
EXT SYN	Switch input to control ON and OFF of S-TRIG OUT and KEYBOARD OUT
TRIG MODE	Switch input to determine single or multiple trigger mode S-TRIG OUT

POLYMOOG SYNTHESIZER SPECIFICATIONS (Continued)

CONTROL INPUTS (Continued)

SUSTAIN	Switch input to control final decay when front panel final DECAY switch is in MAN position
GLIDE	Switch input to control KEYBOARD OUT, GLIDE ON, OFF
VCF, RES, AUX	0dBm

CONTROL OUTPUTS

S-TRIG	+15 to 0.00 volts either single or multiple trigger, determined by TRIG MODE input control
KEYBOARD OUT	Monophonic keyboard control voltage output for controlling external synthesizers
KEYBOARD SCALE	Adjusts keyboard output control voltage from 0.95 ± 0.03V to 1.2 ± 0.05V/octave
GLIDE CONTROL	Varies portamento to time of keyboard control voltage

CONTROL OUTPUTS (Continued)

BAL MIX	XLR Balanced line 600 ohm output
MIX	Single ended mix output derived from BAL MIX connector; insertion of jacks automatically unbalances BAL MIX to provide single ended output, 600 ohms, 0dBm
VCF	Voltage controlled filter channel output, 600 ohms, 0dBm
PRE-MODE	Internal fixed filter channel output, 600 ohms, 0dBm

GENERAL

Power Consumption	95-130/190-260V 50-60Hz; 0.5/0.25A
Unit Weight	71 lbs (32kg)
Shipping Weight	100 lbs (46kg)
Unit Size	45-1/2 x 22-1/4 x 6 in. (116 x 54 x 16cm)
Shipping Size	49 x 27 x 9.5 in. (125 x 64 x 25cm)

POLYMOOG KEYBOARD SPECIFICATIONS

SOUND SOURCES

Number of Oscillators	2 (71-pitch ranks; slaved to precision VCO)
Articulators	142 (VCA's and VCF's for each key)
Frequency Range	E_1-D_7, 71 note keyboard: pitch ribbon and external frequency control give maximum of ± 1 octave pitch control
Pitch Stability	± 0.2% (± 1/3 cent)
Pitch Ribbon Range	± 7 Semitones minimum
Fine Tune Range	± 1 semitone
Beat Tune Range	± 1/4 semitone

CONTROL INPUT JACKS

SWELL	30dB control 0 to 5 VAC. Input impedance-200K
FILTER	0.5 volts/octave input impedance. 1 megohm (for BRASS voices)
TRIGGER Mode	Switch to ground gives single selectable trigger or multiple trigger
PITCH	0.7 volts/octave
SUSTAIN	Switch to ground gives sustain
Accessory Power Outputs	± 15, +5 VDC at 100 mA available for each supply voltage

VOICES

Number	14 programmed
Voice Controls	MODULATION RATE and AMOUNT, OCTAVE BALANCE (3), ATTACK (sustaining voices)
BASS FILTER	14 programmed; variable CUTOFF FREQUENCY and separate GAIN controls
MAIN OUTPUT	Nominal output level 0dBm (0.7 volts); output impedance-less than 3K
BASS OUTPUT	Nominal output level 0dBm (0.7 volts). Output impedance-less than 3K. Plugging into bass output automatically isolates bass signal from main output)

GENERAL

Power Consumption	95-130/190-260 VAC; 50-60Hz; 50 watts max
Unit Weight	60 lbs. (30kg)
Shipping Weight	90 lbs (41kg)
Unit Size	45-1/2 x 22-1/4 x 6 in. (116 x 54 x 16cm)
Shipping Size	49 x 27 x 9.5 in. (125 x 69 x 24cm)

CONTROL OUTPUT JACKS AND CONTROLS

Keyboard Control Voltage	Scale adjustable from 0.9 to 1.1 volts/octave with rear panel SCALE potentiometer. RANGE adjustalbe ± 1-1/2 semitones
Trigger	S-TRIG (+15 to 0.0VAC): single/multiple determined by TRIG MODE switch or footswitch

SECTION 1
GENERAL

1.1 INTRODUCTION

This manual supplies servicing and parts information for Polymoog Synthesizer Model 203A and Polymoog Keyboard Model 280A, manufactured by Moog Music Inc., 2500 Walden Avenue, Buffalo, New York 14225. Both instruments have a fully polyphonic standard keyboard allowing any number of notes to be played simultaneously.

The manual is divided into two volumes. Volume I, consisting of 8 sections, provides circuit descriptions, troubleshooting and adjustments, and replacement parts lists. Volume II supplies schematics and printed circuit board part location diagrams.

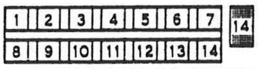
Section 1 of Volume I provides general information for both Polymoog and Polymoog Keyboard. Sections 2 through 8 describe the instruments in "board-number-sequence". A quick reference table, Table 1-1, identifies the printed circuit boards with specific sections in Volume I. Since most adjustments are performed on printed circuit boards 7 and 9, illustrations are provided on the inside rear cover for convenience while performing these adjustments.

Volume I is bound and may be removed from the loose leaf binder and used separately by slightly turning and disengaging the plastic binder clips. The schematic section (Volume II) is then light enough to place on top of an opened Polymoog without damaging or bending any components.

The nomenclature on the Polymoog was changed after 2500 instruments were produced in order to identify the difference between the capabilities of the Polymoog Synthesizer, the most versatile instrument and the Polymoog Keyboard, a more simplified version with fourteen presets. Many photographs and explanations exist within this manual which refer to Polymoog Synthesizer Model 203A and the Polymoog Keyboard Model 280A. To make the distinction easier for service technicians who are new to the instruments, tabs in the schematic section (Volume II) are color coded in blue for those circuits which are unique to the Polymoog Keyboard. In addition, a reduced version of the front panel selector buttons has been added to each page of both Volume I and Volume II. This chart identifies the information pertaining to one of the instruments. If both front panel selector buttons appear on the same page, that particular text or illustration applies to both Polymoog and Polymoog Keyboard, as indicated in the example that follows.

1
2
3
4
5
9
6
7
8
9
•

POLYMOOG SYNTHESIZER



POLYMOOG KEYBOARD

1.2 PRINTED CIRCUIT BOARD ABBREVIATIONS

Table 1-1 lists each printed circuit board and associated abbreviation used throughout this service manual, including the board number and the section. Abbreviations used for interconnection follow in Table 1-2, along with a connector identification illustration, shown in Figure 1-1.

TABLE 1-1
PRINTED CIRCUIT BOARD ABBREVIATIONS

ABBREVIATION	PRINTED CIRCUIT BOARD OR CARD ASSEMBLY	POLYMOOG	POLYMOOG KEYBOARD	BOARD	SECTION
BAL	Balance Card	X	X		3
BY	Bypass Filter	X	X		3
CL	Left Hand Control Board	X		10	7
CL	Left Hand Control Board		X	10	7

TABLE 1-1
PRINTED CIRCUIT BOARD ABBREVIATIONS (Continued)

ABBREVIATION	PRINTED CIRCUIT BOARD OR CARD ASSEMBLY	POLYMOOG	POLYMOOG KEYBOARD	BOARD	SECTION
CR	Right Hand Control Board	X		11	7
DIV	Divider Board	X	X	3	2
HFO	High Frequency Oscillator (Version 1)	X	X	1,2	2
HFO	High Frequency Oscillator (Version 2)	X	X	1,2	2
MBL	Low Mother Board	X	X	4	3
MBM	Medium Mother Board	X	X	5	3
MBH	High Mother Board	X	X	6	3
MOD_n	Modulator Card	X	X		6
MODE	Mode Selector	X		12	7
MODE	Master Voice Selector		X	12	7
PS	Power Supply (Moog)	X	X	13	8
PS	Power Supply (Faratron)	X		13	8
TC	Fixed and Resonant Filters	X		8	5
	Filter No. 1 – String	X		Part of 8	5
	Filter No. 2 – Piano	X		Part of 8	5
	Filter No. 3 – Organ	X		Part of 8	5
	Filter No. 4 – Harpsichord	X		Part of 8	5
	Filter No. 5 – Funk	X		Part of 8	5
	Filter No. 6 – Clavinet	X		Part of 8	5
	Filter No. 7 – Vibes	X		Part of 8	5
	Filter No. 8 – Brass (Version 1)	X		Part of 8	5
	Filter No. 8 – Brass (Version 2)	X		Part of 8	5
TC	Audio Board		X	8	5
	Filter No. 1		X	Part of 8	5
	Filter No. 2		X	Part of 8	5
TL	Reference Oscillator	X	X	7	4
TR	Voltage Controlled Filter	X		9	6
TR	Program Control Board		X	9	6
VOX	Vox Humana		X	14	5

1.3 CONNECTOR NOMENCLATURE

Due to the complexity of this instrument, no overall interconnecting wiring diagram exists. Therefore the interconnection abbreviations and description (Table 1-2) and the connector identification system (Figure 1-1) provide information on how each control and printed circuit board are assembled together.

The first digit (first two digits if the board number is above ten) is the board number, the second number is the connector number on that board and the number after the dash is the pin number within that connector.

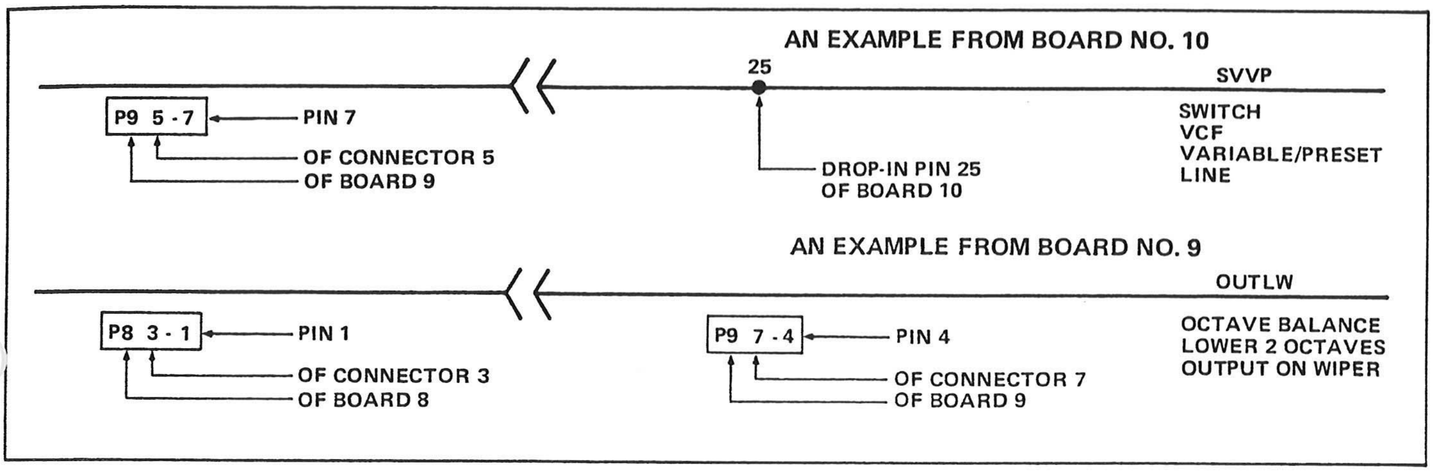

AN EXAMPLE FROM BOARD NO. 10
25
SVVP
P9 5 - 7
PIN 7
OF CONNECTOR 5
OF BOARD 9
DROP-IN PIN 25
OF BOARD 10
SWITCH
VCF
VARIABLE/PRESET
LINE
AN EXAMPLE FROM BOARD NO. 9
OUTLW
P8 3 - 1
PIN 1
OF CONNECTOR 3
OF BOARD 8
P9 7 - 4
PIN 4
OF CONNECTOR 7
OF BOARD 9
OCTAVE BALANCE
LOWER 2 OCTAVES
OUTPUT ON WIPER

FIGURE 1-1 CONNECTOR IDENTIFICATION SYSTEM

TABLE 1-2
INTERCONNECTION ABBREVIATIONS

Buss	indicates common signal to modulator cards (via mother boards or common line to keyboard)
Pot...........	indicates a voltage or current to or from a control (potentiometer)
Potentiometric. .	indicates a variable control signal
Switch	indicates a TTL control line which is activated by a momentary switch (to ground)

ABBREVIATION	DESCRIPTION
A1	Coded binary output No. 1
A2	Coded binary output No. 2
B	BANDPASS mode for RESONATORS
BAL	Balance level from the balance card
BID	BEAT (rate) indicator drive
BIR	BEAT (rate) indicator return
BRITBH	Brightness buss - high (octaves 5 and 6)
BRITBL	Brightness buss - low (octaves 1 and 2)
BRITBM	Brightness buss - medium (octaves 3 and 4)
C	Control lines (gates) of CMOS packs

TABLE 1-2
INTERCONNECTION ABBREVIATIONS (Continued)

ABBREVIATION	DESCRIPTION
CL No. 1 DECAY	Clock (decay) input from RECTANGULAR RANK
CL No. 2 (PW No. 2)	Clock (audio) input for the RECTANGULAR RANK
CL No. 3 (PW No. 1)	Clock (audio) input for SAWTOOTH RANK
CLK	Clock
CLKC1	Clock control for high frequency oscillator (No. 1) RECTANGULAR RANK
CLKC2	Clock control for high frequency oscillator (No. 2) RECTANGULAR RANK
CLR	Clock return line
CLR1	Clock return to phase comparator from divider - oscillator (No. 1) SAWTOOTH RANK
CLR2	Clock return to phase comparator from divider - oscillator (No. 2) RECTANGULAR RANK
CNTM	Contour and unbalanced mother board output
CSTI	Contour S-TRIG INPUT control line
D	Data line
DECPT	DECIMAL POINT (PART–FULL) buss line
DLLBH	Drive level limit buss of highest two octaves (5 and 6)
DLLBL	Drive level limit buss of lower two octaves (1 and 2)
DLLBM	Drive level limit buss of medium two octaves (3 and 4)
E	Equalization mode for RESONATORS (not connected)
EDIRO	External DIRECT OUTPUT line
EFMB	External frequency MODULATION AMOUNT drive buss
EFMC	External frequency MODULATION AMOUNT control INPUT line
ERES	External RESONATOR INPUT line
ESOO	KEYBOARD control ON/OFF for external Synthesizer keyboard circuit
EVCF	External VCF INPUT line
EXFIL	External FILTER INPUT line
EXI	External AUXILIARY INPUT line
EXIT	External AUXILIARY INPUT from top of pot line
EXIW	External AUXILIARY INPUT from pot wiper
FIL	Filter line from modulator VCF capacitors
FIL BRIGHT	Filter brightness line
FOOT	Foot SUSTAIN level
FTSUBH	Foot SUSTAIN for mother board buss–high (octaves 5 and 6) final decay
FTSUBL	Foot SUSTAIN for mother board buss–low (octaves 1 and 2) final decay
FTSUBM	Foot SUSTAIN for mother board buss–medium (octaves 3 and 4)
GLEX	External GLIDE ON/OFF control line
GS	General strobe output
GS	+15 volt DC supply ground sense line from power supply
H	HIGH PASS mode for RESONATORS
I	Inputs of CMOS switch packs
IDLA	Indicator lamp – “1” bit
IDLB	Indicator lamp – “2” bit

TABLE 1-2
INTERCONNECTION ABBREVIATIONS (Continued)

ABBREVIATION	DESCRIPTION
KBBH	Keyboard bottom of the high resistor string
KBBL	Keyboard bottom of the low resistor string
KBLLB	Keyboard lowest level buss
KBBS	Keyboard buss for monophonic keyboard control voltage
KBEX	External KEYBOARD OUTPUT drive signal buss
KBHDB	KEYBOARD high (UPPER) octaves (5 and 6) DECAY RATE buss line
KBHLB	Keyboard highest level buss
KBLDB	KEYBOARD LOWER octaves (1 and 2) DECAY RATE buss line
KBMDB	KEYBOARD MEDIUM octaves (3 and 4) DECAY RATE buss line
KBSC	External KEYBOARD SCALE control line
KBTH	KEYBOARD top of the high resistor string
KBTL	KEYBOARD top of the low resistor string
KCEX	KEYBOARD control ON/OFF for external Synthesizer keyboard circuit
KSTR	KEYBOARD S-TRIG OUTPUT line
KTSM	KEYBOARD TRIGGER MODE SINGLE/MULTIPLE from the external rear panel jack
L	LOW PASS mode for RESONATORS
LIMIT	Drive level limit for SUSTAIN pedal
MACG	Modulation amounts contour generator for the string preset
MBBL	Mother board buss lines
MXO1	MIX OUTPUT No. 1
MXO2	MIX OUTPUT No. 2
MXO3	MIX OUTPUT No. 3
O	Outputs of CMOS switch packs
OS2C	Oscillator No. 2 (input) control line from rear panel external PITCH for rectangular rank
OSC1	Oscillator No. 1 high frequency output for SAWTOOTH RANK
OSC2	Oscillator No. 2 high frequency output for RECTANGULAR RANK
OSEXC	Oscillator external control input line labeled PITCH for both RECTANGULAR and SAWTOOTH RANK
OUT No. 1	Current output No. 1 from modulator cards for SAWTOOTH RANK
OUT No. 2	Current output No. 2 from modulator cards for RECTANGULAR RANK
OUTH	OCTAVE BALANCE slider drive high (octaves 5 and 6) from high mother board output
OUTHW	OCTAVE BALANCE slider drive high (octaves 5 and 6) output on wiper
OUTL	OCTAVE BALANCE slider drive low (octaves 1 and 2) from low mother board output
OUTLW	OCTAVE BALANCE low (octaves 1 and 2) output on wiper
OUTM	OCTAVE BALANCE slider drive medium (octaves 3 and 4) from medium mother board output
OUTMW	OCTAVE BALANCE medium (octaves 3 and 4) output on wiper
P1	STRING (10 volt) preset drive line
P2	PIANO (10 volt) preset drive line
P3	ORGAN (10 volt) preset drive line

TABLE 1-2
INTERCONNECTION ABBREVIATIONS (Continued)

ABBREVIATION	DESCRIPTION
P4	HARPSICHORD (10 volt) preset drive line
P5	FUNK (10 volt) preset drive line
P6	CLAVINET (10 volt) preset drive line
P7	VIBES (10 volt) preset drive line
P8	BRASS (10 volt) preset drive line
PBADW	Pot BALANCE DIRECT wiper output line
PBAPT	Pot BALANCE DIRECT wiper output line
PBAPW	Pot BALANCE preset (MODE) wiper output line
PBART	Pot BALANCE RESONATOR top drive line
PBARW	Pot BALANCE RESONATOR wiper output line
PBRIN	Potentiometric brightness node
PCAM	Pot for CONTOUR amount (not used)
PCAMIN	Potentiometric CONTOUR AMOUNT (oscillator No. 1) SAWTOOTH RANK node
PCAMN	Potentiometric CONTOUR AMOUNT node
PCAT	Pot for CONTOUR ATTACK time
PCATN	Potentiometric CONTOUR ATTACK time node
PCDE	Pot for CONTOUR DECAY
PCDEN	Potentiometric CONTOUR DECAY time node
PCSU	Pot for CONTOUR SUSTAIN
PCSUN	Potentiometric CONTOUR SUSTAIN level node
PFMIN	Potentiometric FREQUENCY MODULATION RATE node for SAWTOOTH RANK
PFMZN	Potentiometric FREQUENCY MODULATION/PHASE MODULATION RATE node for RECTANGULAR RANK
PKAT	Pot for KEYBOARD ATTACK
PKATN	Potentiometric KEYBOARD ATTACK node
PKBS	Pot for KEYBOARD SUSTAIN
PKBSN	Potentiometric KEYBOARD SUSTAIN node
PKDH	Pot for KEYBOARD DECAY – high (UPPER four octave) drive
PKDHN	Potentiometric KEYBOARD DECAY RATE – high (UPPER four octave) node
PKDL	Pot for KEYBOARD DECAY – LOWER two octave drive
PKDLN	Potentiometric KEYBOARD DECAY RATE – LOWER two octave node
PKDY	Pot for KEYBOARD DYNAMICS level
PKDYN	Potentiometric KEYBOARD DYNAMICS node
PKGL	Pot (external) KEYBOARD GLIDE
PKGLN	Potentiometric (external) KEYBOARD GLIDE node
PLCMN	Potentiometric clamp level modulator drive node
PO1TN	Potentiometric (oscillator No. 1) SAWTOOTH RANK TUNE node – variable mode only
PO1NTN	Potentiometric (oscillator No. 1) SAWTOOTH RANK TUNE node – preset mode only
POBT	Pot oscillators BEAT RATE voltage control line

TABLE 1-2
INTERCONNECTION ABBREVIATIONS (Continued)

ABBREVIATION	DESCRIPTION
POEM1N	Potentiometric oscillator FREQUENCY MODULATION AMOUNT node for SAWTOOTH RANK
POFM2N	Potentiometric oscillator FREQUENCY MODULATION/PHASE MODULATION AMOUNT node for the RECTANGULAR RANK
POFT	Pot oscillators FINE TUNE voltage control line
PR	Preset (set)
PRF1A	Pot RESONATOR CUT OFF FREQUENCY (No. 1) LOW section
PRFZA	Pot RESONATOR CUT OFF FREQUENCY (No. 2) MID section
PRF3A	Pot RESONATOR CUT OFF FREQUENCY (No. 3) HIGH section
PRGA1	Pot RESONATOR GAIN amount line for (No. 1) LOW section
PRGA2	Pot RESONATOR GAIN amount line for (No. 2) MID section
PRGA3	Pot RESONATOR GAIN amount line for (No. 3) HIGH section
PRQ1	Pot RESONATOR Q (EMPHASIS) for (No. 1) LOW section
PRQ2	Pot RESONATOR Q (EMPHASIS) for (No. 2) MID section
PRQ3	Pot RESONATOR Q (EMPHASIS) for (No. 3) HIGH section
PRQ3	Pot RESONATOR GAIN amount line for (No. 3) HIGH section
PSHN	Potentiometric (pulse width) SHAPE high (octaves 5 and 6) node for RECTANGULAR RANK
PSLN	Potentiometric (pulse width) SHAPE LOWER (octaves 1 and 2) node for RECTANGULAR RANK
PSMN	Potentiometric (pulse width) SHAPE MEDIUM (octaves 3 and 4) node for RECTANGULAR RANK
PSWHN	Potentiometric SAWTOOTH (RANK MIX) level high (UPPER four octave) node
PSWLN	Potentiometric SAWTOOTH (RANK MIX) level LOWER two octave node
PVBA	Pot VCF BALANCE line
PBAOT	Pot BALANCE DIRECT top drive line
PVCO	Pot for VCF CUT OFF
PVCON	Potentiometric VCF CUT OFF node
PVEM	Pot for VCF EMPHASIS
PVEMN	Potentiometric VCF EMPHASIS node
PVKB	Pot for VCF KEYBOARD AMOUNT
PVKBP	Potentiometric VCF keyboard preset drive node
PVMA	Pot for VCF modulation AMOUNT
PVMAN	Potentiometric VCF modulation AMOUNT node
PVMR	Pot for VCF modulation RATE
PVMRN	Potentiometric VCF modulation RATE node
PVSH	Pot for VCF SAMPLE and HOLD
PVSHN	Potentiometric VCF SAMPLE and HOLD node
PW No. 2	Pulse width control (No. 2) line for the RECTANGULAR RANK
PWMHN	Pulse width AMOUNT of the high (UPPER four octaves) of the RECTANGULAR WAVESHAPE/MODULATION section
PWMLN	Pulse width AMOUNT of the (LOWER two octaves) of the RECTANGULAR WAVESHAPE/MODULATION section

TABLE 1-2
INTERCONNECTION ABBREVIATIONS (Continued)

ABBREVIATION	DESCRIPTION
PWSHB	Pulse width SHAPE for highest buss (octaves 5 and 6) of the RECTANGULAR WAVESHAPE/MODULATION section
PWSLB	Pulse width SHAPE for lower buss (octaves 1 and 2) of the RECTANGULAR WAVESHAPE/MODULATION section
PWSMB	Pulse width SHAPE for medium buss (octaves 3 and 4) of the RECTANGULAR WAVESHAPE/MODULATION section
Q	Flip flop output
$\overline{Q}$	Inverted flip flop output
$\overline{Q}2$	Inverted flip flop output No. 2
$\overline{Q}3$	Inverted flip flop output No. 3
$\overline{Q}4$	Inverted flip flop output No. 4
RIBB	Ribbon pitch controller voltage input line
RP1	Reset preset buss line
SCL14	Switch clock oscillator No. 4′ SAWTOOTH RANK
SCL18	Switch clock oscillator No. 8′ for SAWTOOTH rank
SCL26	Switch clock oscillator No. 2 16′ for RECTANGULAR RANK
SCL28	Switch oscillator No. 2 8′ for RECTANGULAR RANK
SFTEX	Switch external foot switch SUSTAIN for final decay drive line
SKH	Switch for VCF KEYBOARD high (UPPER) drive
SKL	Switch VCF KEYBOARD LOWER drive line
SK01H	Switch KEYBOARD WAVESHAPE (oscillator No. 1) for the (high) UPPER four octaves of the SAWTOOTH RANK
SK02H	Switch KEYBOARD WAVESHAPE (oscillator No. 2) for the (high) UPPER four octaves of the RECTANGULAR RANK
SK01L	Switch KEYBOARD WAVESHAPE (oscillator No. 1) for LOWER two octaves of the SAWTOOTH RANK
SK02L	Switch KEYBOARD WAVESHAPE (oscillator No. 2) for LOWER two octaves of the RECTANGULAR RANK
SKTM	Switch KEYBOARD VCF to mode (ALL/SPLIT)
SP1	Switch preset No. 1 for STRINGS
SP2	Switch preset No. 2 for PIANO
SP3	Switch preset No. 3 for ORGAN
SP4	Switch preset No. 4 for HARPSICHORD
SP5	Switch preset No. 5 for FUNK
SP6	Switch preset No. 6 for CLAVINET
SP7	Switch preset No. 7 for VIBES
SP8	Switch preset No. 8 for BRASS
SP9	Switch preset No. 9 VARIABLE
SPB1	Switch preset bit "1"
SPB2	Switch preset bit "2"
SPB3	Switch preset bit "3"
SPLFR	Switch preset LOCK FREE line
SREH	Switch KEYBOARD RESONATOR AND MODE high (UPPER) four octaves

TABLE 1-2
INTERCONNECTION ABBREVIATIONS (Continued)

ABBREVIATION	DESCRIPTION
SREL	Switch KEYBOARD RESONATOR AND MODE LOWER two octaves
SREM1	Switch RESONATOR BANDPASS mode
SREM2	Switch RESONATOR equalization BANDPASS mode
SREM3	Switch RESONATOR HIGHPASS mode
SREM4	Switch RESONATOR LOW PASS mode
SRE00	Switch RESONATORS ON/OFF
SREV	Switch KEYBOARD RESONATOR AND MODE VARIABLE (not used)
SVCH	Switch VCF high UPPER (four octaves) KEYBOARD audio control line
SVCL	Switch VCF LOWER (two octaves) KEYBOARD audio control line
SVFTO	Switch front panel SUSTAIN final decay drive line ON/OFF
SV00	Switch VCF ON/OFF
SVVP	Switch VCF VARIABLE/PRESET
SWLBH	SAWTOOTH RANK level buss high (octaves 5 and 6)
SWLBL	SAWTOOTH RANK level buss LOW (octaves 1 and 2)
SWLBM	SAWTOOTH RANK level buss medium (octaves 3 and 4)
TRGH	Trigger buss high for upper 4 octaves of monophonic keyboard
TRGL	Trigger buss for lower two octaves of monophonic keyboard
VCC	5-volt power supply line
VCFO	VCF output line
VCH	Audio reference voltage of 4.85VDC
VCHR	VCH reference voltage to mother board
VP1	VARIABLE PRESET line
V + S	+15-volt DC supply sense line from power supply
XX	Common drive line
YY	Common drive line
ZZ	Common drive line for CMOS 4007 packs

1.4 GENERAL

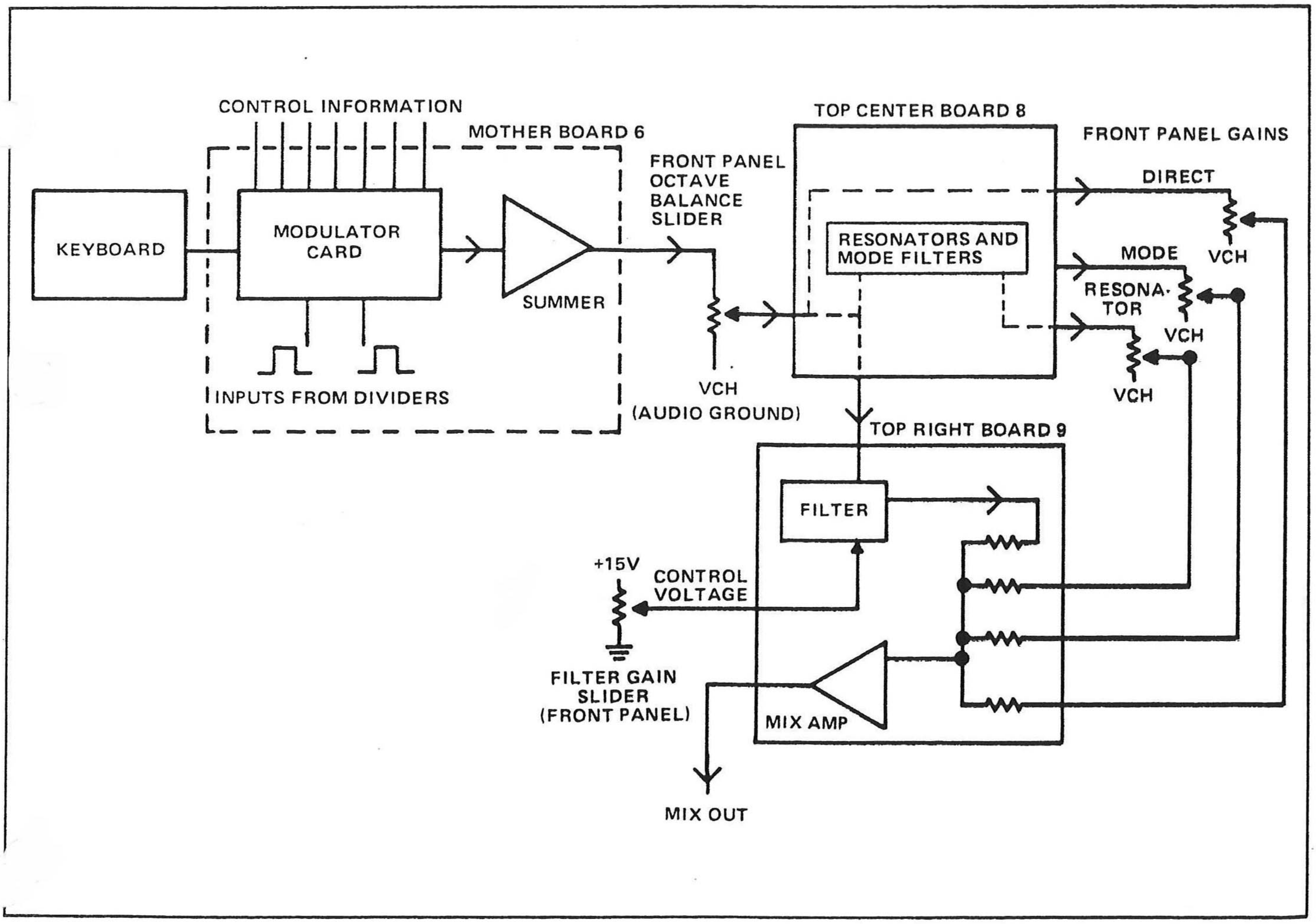
The Polymoog and Polymoog Keyboard are fully polyphonic keyboards taking both into the realm of electronic pianos, organs, vibes, brass and string effects. Control of these instruments is effected by the keyboard and the front panel control assembly, consisting of a variety of potentiometers, switches, and associated circuitry. Figure 1-2 is a simplified block diagram of the Polymoog and Polymoog Keyboard systems.

The overall description of the instrument that follows was developed specifically for the Polymoog Synthesizer. Many principals apply to the Polymoog Keyboard but reference should be made to the individual printed circuit board description for further information.

A chart depicting Polymoog signal flow is included for additional information.

1.5 POWER SUPPLY

The power supply is comprised of three precision regulated power sections providing +5, +15 and -15 VDC. Adjustments for the supply voltages are located on the power supply printed circuit board which may be removed as a subassembly for servicing. The individual power supply sections have remote ground and supply sense lines which are applied directly to the left and right hand control panel boards (CL and CR) of the front panel control assembly. The sense lines for the +5 and -15 VDC supplies are terminated at the CL and CR boards which in turn distribute power to other boards in the system. The +15 VDC sense line terminates on the reference and modulation oscillator waveshape and keyboard control board (TL) because the reference oscillators located on the TL board are sensitive to +15 VDC supply voltage variations. Each individual power supply section incorporates short circuit and over voltage circuit protectors. The over voltage circuit protectors, called transorbs,


CONTROL INFORMATION
MOTHER BOARD 6
KEYBOARD
MODULATOR CARD
SUMMER
INPUTS FROM DIVIDERS
FRONT PANEL OCTAVE BALANCE SLIDER
VCH
(AUDIO GROUND)
TOP CENTER BOARD 8
RESONATORS AND MODE FILTERS
FRONT PANEL GAINS
DIRECT
MODE
VCH
RESONA-TOR
VCH
VCH
TOP RIGHT BOARD 9
FILTER
+15V
CONTROL VOLTAGE
FILTER GAIN SLIDER (FRONT PANEL)
MIX AMP
MIX OUT

POLYMOOG SIGNAL FLOW CHART

are located on the control boards and clip off excessive voltage transients. Should a very high voltage occur accidentally on the power supply line, these circuit protectors go to a dead short condition, shutting down the supply and protecting the system from a massive burn out.

In addition to the three main supply voltages provided by the main power supply, there are two secondary supply voltages provided by two regulators on the CR board. Voltages of +4.85 and -5.5 VDC are derived from the +5 and -15 VDC voltage rails respectively and adjustments for these two supplies are located on the CR board. The +4.85 VDC voltage serves as the internal audio reference rail. Final output audio voltages are re-referenced to ground via an output transformer or directly via capacitors. The +4.85 and -5.5 VDC rails provide power to the main modulator/generator section and several other functio

The +5 VDC supply provides power for the T
(transistor-transistor logic) and LEDs (light emitti
diodes) throughout the instrument, the +15 VDC r
drives the CMOS circuitry, and, with a few exceptio
the operational amplifiers are powered from both +
and -15 VDC rails. All high voltage is covered a
located at the left rear of the instrument near t
power switch. This cover should not be remov
unless it is necessary to replace the fuses and if fu
are replaced, install this cover immediately to preve
possible shock. Otherwise, accessible circuit points a
free of shock hazard. The power supply connectors
various boards in the system may be disconnect
without damaging the remaining connected boards
provide a convenient way of locating power supp
shorts should they occur.

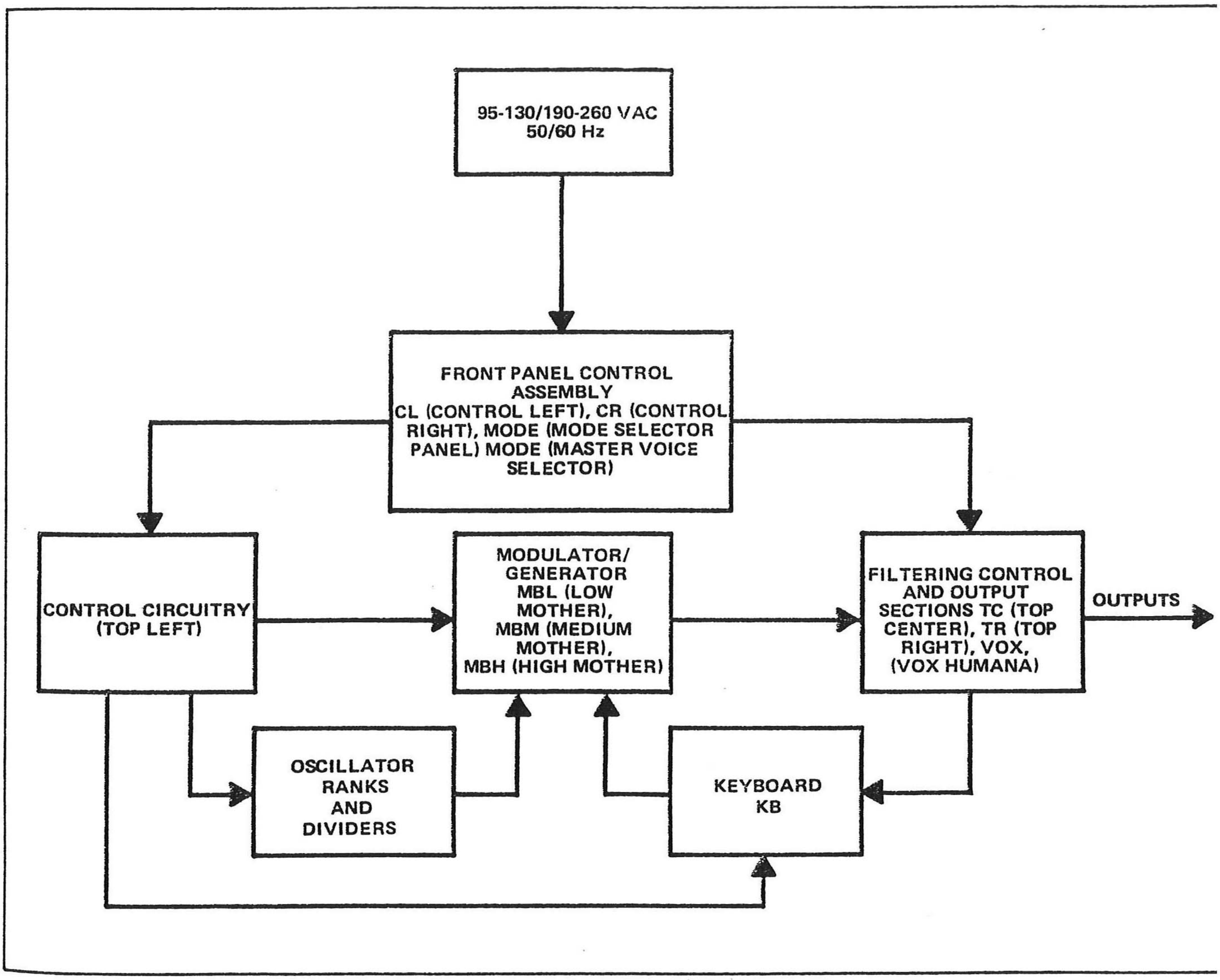

95-130/190-260 VAC
50/60 Hz
FRONT PANEL CONTROL ASSEMBLY CL (CONTROL LEFT), CR (CONTROL RIGHT), MODE (MODE SELECTOR PANEL) MODE (MASTER VOICE SELECTOR)
CONTROL CIRCUITRY (TOP LEFT)
MODULATOR/ GENERATOR MBL (LOW MOTHER), MBM (MEDIUM MOTHER), MBH (HIGH MOTHER)
FILTERING CONTROL AND OUTPUT SECTIONS TC (TOP CENTER), TR (TOP RIGHT), VOX, (VOX HUMANA)
OUTPUTS
OSCILLATOR RANKS AND DIVIDERS
KEYBOARD KB

FIGURE 1-2. POLYMOOG AND POLYMOOG KEYBOARD SIMPLIFIED BLOCK DIAGRAM

1.6 FRONT PANEL CONTROL ASSEMBLY

The front panel control assembly provides control currents and digital logic levels to the system whose values are determined by its control potentiometers and switches. Table 1-3 contains a list of front panel controls with their associated control function and printed circuit board. Referring to the detailed block diagram, Volume II, note that the control panel assembly consists of six major parts: left and right hand control panel potentiometers and printed circuit boards located under the front panel extrusion, ribbon pitch controller and mode selector control (master preset) mounted on the center extrusion.

Digital logic levels are derived directly from the states of TTL latching circuits which are electronic equivalents of multiposition switches. These multiflop latches are set to the desired state by depressing the appropriate momentary contact pushbutton. Associated with each of these multiflop latches are LED indicators. Each time a master preset button is activated, these latches, located on the control boards, are positioned to a set of preselected states via diodes on the control boards. At any time after a master preset button is released, this particular preset state may be overridden by depressing one of the individual buttons of the set associated with a particular latch. Thus, the status of these latches may be changed in a preset selected manner by the mode selector master preset or set to the desired state individually using the buttons associated with that particular latch. Refer to Figure 1-3.

In addition to latches which provide digital control signals directly to the system, there are a set of two-state latches which determine whether a particular linear control variable is determined by a preset resistor network or by a front panel potentiometer. These latches are called VAR-PRE latches. When any one of the eight master modes is selected by depressing one of the eight mode selector switches in the master preset section, all of these latches are set to the PRE state via the RP1 buss line. If No. 9 pushbutton is depressed, all of these latches are set to the VAR state via the VP1 buss line. As explained previously, each of these VAR-PRE latches may be individually set to the desired state by depressing the appropriate button associated with that particular latch. In general, these VAR-PRE latches control a number of specific functions at one time. For example, the VAR-PRE selector associated with frequency modulation (FM) on the left hand control panel controls four specific functions, two independent FM rates and FM amounts. When a particular section is in the PRE mode, a set of internal program resistors driven by preset drive lines and tied together in

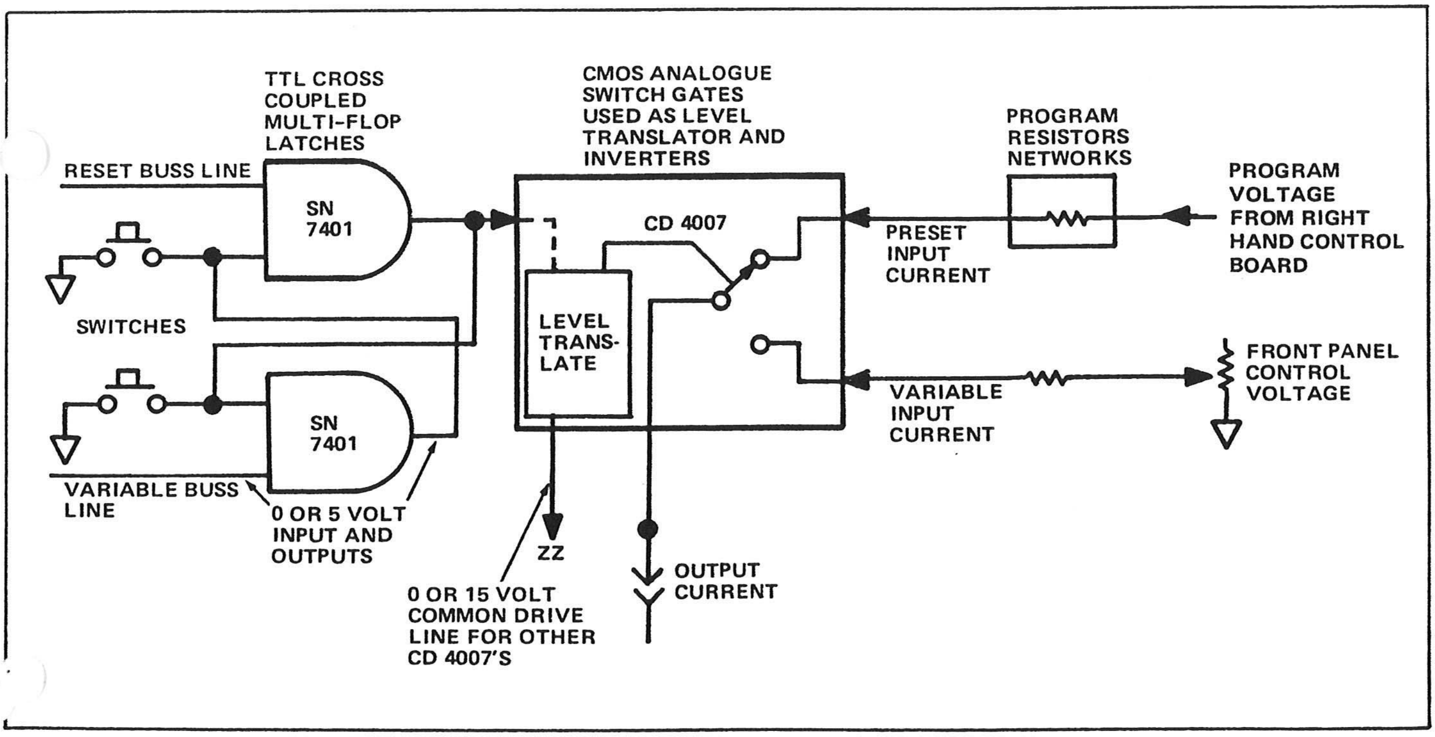

TTL CROSS COUPLED MULTI-FLOP LATCHES
CMOS ANALOGUE SWITCH GATES USED AS LEVEL TRANSLATOR AND INVERTERS
PROGRAM RESISTORS NETWORKS
RESET BUSS LINE
SN 7401
CD 4007
PROGRAM VOLTAGE FROM RIGHT HAND CONTROL BOARD
PRESET INPUT CURRENT
SWITCHES
LEVEL TRANS-LATE
FRONT PANEL CONTROL VOLTAGE
SN 7401
VARIABLE INPUT CURRENT
VARIABLE BUSS LINE
0 OR 5 VOLT INPUT AND OUTPUTS
ZZ
OUTPUT CURRENT
0 OR 15 VOLT COMMON DRIVE LINE FOR OTHER CD 4007'S

FIGURE 1-3 TYPICAL CONTROL BOARD SEQUENCE

common on the output side provide program currents for the active preset to a set of CMOS analog switch gates. Associated with each linear function control is an individual CMOS switch. The group of CMOS switches associated with a particular block, controlled by one of the VAR-PRE latches, route the program currents to an appropriate control summing node located on either the TL or TR circuit boards.

The FINE TUNE and BEAT rate controls located on the far left of the panel provide tuning control and are active at all times. Figure 1-7 shows the individual controls associated with each functional block controlled by the VAR-PRE latches. The front panel slide potentiometers act as voltage dividers and in general, are strapped between ground and +15 VDC. However, six controls (frequency modulation and amount of shape modulation controls) are driven between ground and a potential determined by circuitry on the TR board, which in turn may be controlled via the MOD AMT connector on the rear panel.

The center panel mode selector control (master preset section) utilizes circuitry located on the CR board to provide control signals for setting the various multiflop latches described previously. Information from the mode selector control pushbuttons is encoded to binary form and latched by TTL circuitry on the CR board. This encoded binary representation of the active preset is sent to several places in the system and then decoded back to linear code for driving the P lines which drive the program resistors. In addition, the binary encoded signal drives a seven-segment decoder (located on the mode selector control board) to provide drive for the seven-segment numeric display producing a visual indication of the active preset.

The "•" pushbutton on the mode selector control toggles a flip-flop which defeats the RP1 action explained previously. When the decimal point indicator is illuminated, depressing one of the eight preset pushbuttons does not reset the VAR-PRE latches and these latches remain in the state at which they were last set. Thus, the decimal point pushbutton serves the purpose of a cancel defeat.

The RIBBON PITCH CONTROLLER, located in the center of the panel, is a linear resistance element with approximately plus and minus 5 VDC applied to the top and bottom of the ribbon. When the ribbon is depressed, a metallic element above the resistance element contacts the resistor and provides a voltage, which may be continuously varied by moving the finger across the ribbon element. This voltage is applied to the reference oscillators located on the TL board. This ribbon element plugs into the CL board and may be removed from the front panel without disassembling the front panel assembly.

The resonator controls located on the right hand panel are direct circuit audio controls as opposed to voltage controls. The MASTER GAIN CONTROLS and OCT BAL controls located on the far left are also direct audio controls with the exception of the VCF master gain control which is a voltage control.

In summary, the front panel control assembly serves as an overall systems controller interface converting and routing the settings of switches and potentiometers controlled by the player to the appropriate electronic control signals.

1.7 CONTROL CIRCUITRY (Refer to Figure 1-4)

The control circuitry is located on the TL board and: (1) converts and scales control currents from the front panel control assembly to voltages required by the modulator/generator section; (2) generates a set of d-c carrier buss line drives to the keyboard under control of signals provided by the front panel control assembly; and (3) generates reference oscillator signals at approximately 1.3 kHz with phase lock circuitry to control the sawtooth and rectangular rank oscillators.

The first item includes three modulation oscillators with associated voltage controlled amplifiers (two used for frequency modulation and one for pulse width modulation) to provide a rectangular pulse width, sawtooth level, drive level limit and decay rate functions.

The modulation oscillators and their associated voltage controlled amplifiers determine the amount of modulation applied to various control points and are essentially identical. The oscillator employs a CA3080 integrated circuit as a current source to a capacitor whose voltage is buffered by a voltage follower driving a Schmitt trigger which switches the plus input of the CA3080, reversing the current flow to the capacitor. The equal rates of positive and negative integration are determined by bias current applied to the CA3080 controlled by rate function controls on the front panel assembly. The triangular output from the modulation oscillators drive another

CA3080 integrated circuit used as a voltage controlled amplifier. In this case, bias current applied to the CA3080 is multiplied by the triangular voltage applied to its voltage inputs resulting in an output current proportional to the product of bias current and voltage input. Modulation oscillator No. 2 drives its amount voltage controlled amplifier (VCA) at a higher level than the others, resulting in a rounding off of the waveform at the output of the VCA. This intentional rounding produces an approximate sinewave output, the input voltage characteristics of the CA3080 providing a "soft" limiting.

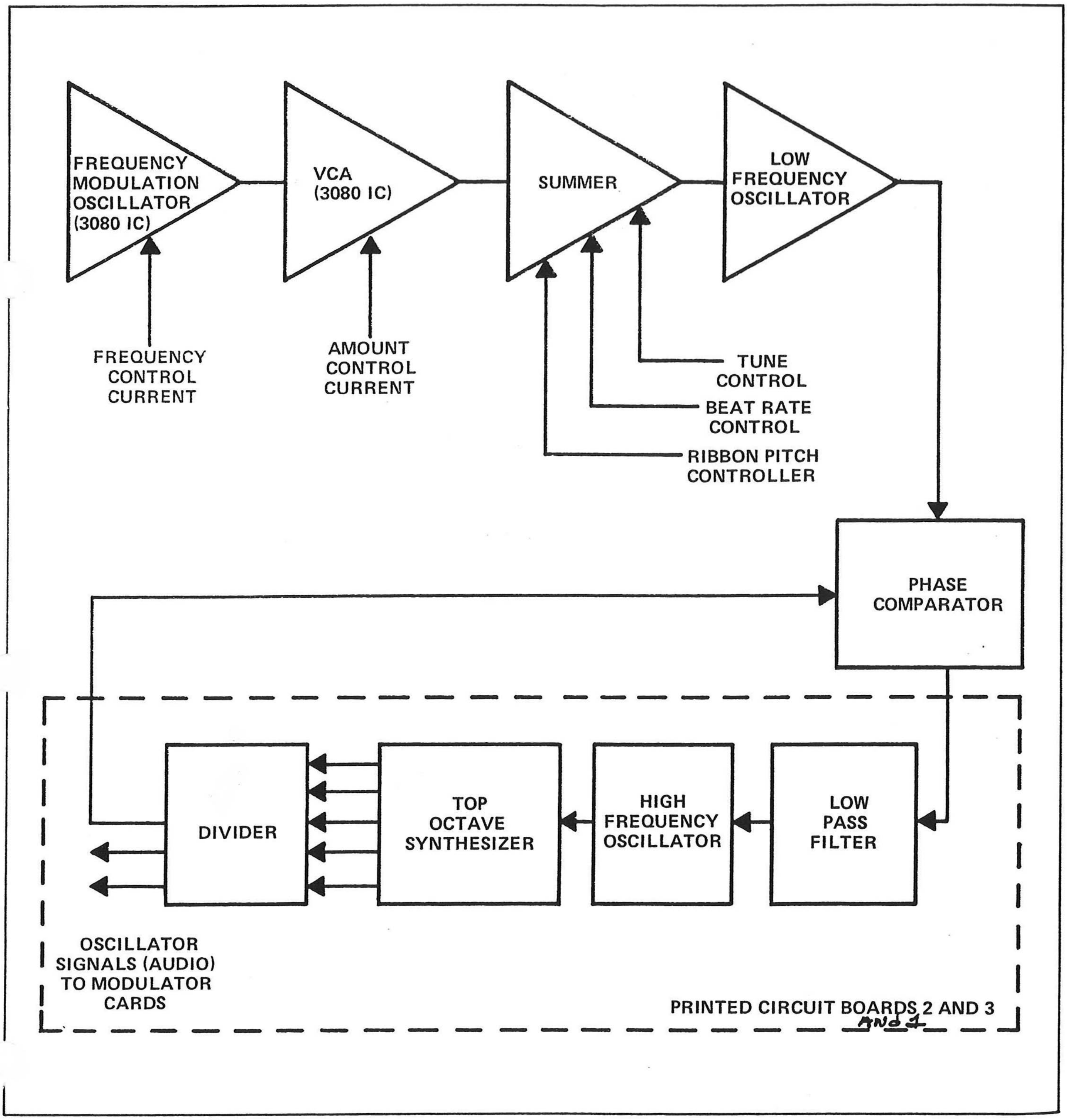

FREQUENCY MODULATION OSCILLATOR (3080 IC)
VCA (3080 IC)
SUMMER
LOW FREQUENCY OSCILLATOR
FREQUENCY CONTROL CURRENT
AMOUNT CONTROL CURRENT
TUNE CONTROL
BEAT RATE CONTROL
RIBBON PITCH CONTROLLER
PHASE COMPARATOR
DIVIDER
TOP OCTAVE SYNTHESIZER
HIGH FREQUENCY OSCILLATOR
LOW PASS FILTER
OSCILLATOR SIGNALS (AUDIO) TO MODULATOR CARDS
PRINTED CIRCUIT BOARDS 2 AND 3
AND 1

FIGURE 1-4 TYPICAL FLOW FOR RECTANGULAR RANK OSCILLATOR ON TOP LEFT BOARD NO. 7

The outputs of the modulation oscillator amount VCA are applied to two reference oscillators for frequency modulation and to the rectangular pulse width circuitry for frequency modulation and pulse width modulation effects, respectively. Simple operational amplifier circuits with bias trim control are used in the rectangular pulse width circuit to provide a d-c control voltage to the low, medium and high mother boards (MBL, MBM, and MBH) which contain the modulator/generator circuits. Currents for tuning control from the front panel control assembly are added to the current from the frequency modulation oscillator amount VCAs to provide a composite control signal for the reference oscillators.

The sawtooth level, drive level and decay controls are comprised of simple operational amplifier circuits with d-c bias trim adjustments and convert currents (provided by the front panel control circuitry) to d-c control voltages which are applied to the mother boards in the modulator/generator section.

The keyboard circuitry is best explained in conjunction with the keyboard itself. The Polymoog keyboard contains two independent sections, a polyphonic keyboard section and a monophonic keyboard section. The monophonic keyboard section is described in conjunction with the TR circuit board of the filtering and output sections. In the polyphonic keyboard section, depressing a key applies a composite signal to the mother board modulators controlling three basic sound generating functions; attack, sustain level and dynamics. The attack time and sustain level are controlled by the pulse width and pulse height, respectively, of a 20 kHz carrier pulse train. The dynamic control signal is a residual d-c voltage across a parallel RC network. With no key depressed, a d-c or static voltage is applied across this parallel RC network along with a carrier signal and when a key is depressed, this parallel RC network is released from its charging buss. After a certain key travel distance, the residual d-c potential applied to the top of the RC network is applied to the corresponding modulator on the mother board causing a "kick" in the loudness contour, the signal which basically turns the sound on and off. If a key is depressed very rapidly, the residual d-c voltage across the RC network is large and causes a correspondingly large "kick" in the loudness contour. If a key is depressed slowly, the original voltage across this RC network has decayed to a lower value causing a correspondingly lower or smaller "kick" in the loudness contour. As mentioned previously, when the top of the RC network is applied to the individual modulator board, attack, sustain level and dynamic information is conveyed on a single wire.

The low voltage sides of all 71 RC networks for all notes are tied together to the low level buss. The high voltage or charging buss is a composite d-c/a-c signal maintained at a constant peak potential. The front panel KB DYN control changes the d-c potential of the low level buss so that as this potential is raised, the minimum "kick" (a key depressed very slowly) applied to the contour generator increases. However, as this low level potential is raised, the difference in potential appearing across the RC network decreases resulting in a less dynamic sensitivity effect. In other words, a fixed control operating dynamic range is split between the fixed "kick" or lowest level provided by the potential on the lowest level buss and the dynamic head room.

The composite d-c/a-c signal appears as a voltage drive on the lowest level buss. Because of strong a-c coupling between the lowest level buss and the highest level buss (charging buss), the highest level buss is driven from a current source to provide an offset between the two busses. The peak detector and regulator associated with the highest level current source detects the peak level on this buss and regulates the current source so that the peak value is constant. This regulator takes effect whenever the lowest level is changed via the front panel KB DYN control or when the sustain level (determined by the carrier pulse height) is changed. The peak detector and regulator associated with the lowest level buss senses the peak level of the lowest level buss and, if this level should begin to exceed the level of the highest level buss, prevents any further increase in the lowest level potential. Increasing the sustain level (20 kHz pulse height) will reduce the baseline potential of the highest level buss via its associated peak detector and regulator.

An overall dynamic range is achieved or reached by a combination of a dynamic "kick," a minimum or fixed "kick " and a sustain drive. The complex interaction of these three controls is governed in a feedback fashion by the peak detectors and regulators. Since every electronic circuit has a maximum dynamic range and if various drive mechanisms are to be capable of achieving an essentially full dynamic range, some mechanism must be provided to force one of the mechanisms to "give" when another one is pushed toward its maximum. In the Polymoog, this is accomplished by limiting the minimum "kick" and/or the dynamic effect as the sustain level is increased. Thus, if the sustain level is set at maximum, there will be no d-c "kick" related to dynamic effect. Intermediate control settings result in mixed modes which provide combinations of dynamic and sustained contours.

The third major section on the TL board contains two precision voltage controlled oscillators whose center frequencies are approximately 1.3 kHz and two phase comparators. High frequency voltage controlled oscillators which drive conventional top octave synthesizers are located on the high frequency oscillator boards of the divider and are synchronized to the reference oscillators using phase comparators. The reference oscillators are driven from precision temperature regulated exponential voltage-to-current converters. This overall system provides an extremely stable pitch control with precision exponential (constant volt/octave) control.

Synchronization of the high frequency oscillators with the reference oscillators is accomplished by comparing a divided down version of the high frequency oscillator output with the reference oscillator output in the phase comparator and driving the high frequency voltage controlled oscillator from the output of the phase comparator. This is a conventional phase-lock-loop configuration.

There are two basic modes of operation for the oscillator systems. In the FREE mode, both oscillator systems run completely independent. In the LOCK mode, both high frequency voltage controlled oscillators are slaved to sawtooth reference oscillator No. 1. However, the reference frequency for the second oscillator system is not the direct output of the first reference oscillator, but rather a phase modulated version of this reference oscillator signal. Thus, while both high frequency voltage controlled oscillators are slaved to reference oscillator No. 1, they may be phase modulated with respect to each other to provide choral effects and yet retain the advantages of locked operation, that is, zero relative frequency drift.

Extremely stable oscillators are required as it is very desirable to be able to set and maintain the two oscillators at very small frequency differences. The beat rate or frequency difference between the two reference oscillators is indicated by a front panel LED driven by the beat rate detector which is in turn driven by the two reference oscillators. This beat detector is a simple OR function between the two oscillators.

The phase comparators are edge triggered digital type phase comparators which do not lock on harmonics but require an exact frequency match on its two inputs for locking. Reference oscillator No. 1, the master oscillator, may be tuned over a plus or minus musical sixth by the ∿ RANK TUNE variable control on the front panel and both reference oscillators may be tuned over ±2 semitones by the FINE TUNE control. In addition, reference oscillator No. 2 may be tuned ±1/2 semitone by the BEAT control. Both oscillators are driven simultaneously over a plus or minus musical sixth by the ribbon PITCH CONTROLLER and the pitch of both oscillators may be varied simultaneously by applying a control signal to the rear panel PITCH input connector. The stereo ring on this jack permits pitch control of oscillator No. 2 only.

1.8 MODULATOR/GENERATOR

The modulator/generator section, consisting of the low, medium and high mother boards, performs the main signal generation in the Polymoog. Each mother board contains a number (24 for low and medium and 23 for high) of small plug-in modulator boards each containing a number of discrete components and a custom integrated circuit. In addition, each mother board contains a number of coupling capacitors, filter capacitors and an output summing amplifier. Voltages on control lines bussed in common to all modulator boards control basic parameters of sound generation, such as decay rate, pulse width, sawtooth amplitude, brightness or degree of filtering, final decay on-off and maximum contour level. Each plug-in modulator board contains the functions of a contour generator, a double VCA, 2-pole filter, final decay on-off and sawtooth and rectangular wave shaping. Each modulator board is driven by two capacitively a-c coupled audio oscillator inputs derived from the divider board. These two differentiated square waves are converted to a variable width pulse and a sawtooth waveform in the custom integrated circuit. When a key is depressed, a composite signal controlling attack, dynamic and sustain level information is transmitted to each modulator board. This composite drive signal is converted by the custom integrated circuit and a single capacitor into the desired contour which internally modulates, filters and combines two audio waveforms. The output from each modulator board is a differential current and corresponding outputs are bussed together and applied directly to the summing node of the current-to-voltage converter operational amplifiers. Each mother board has a separate voltage output for a two octave section and these three outputs are summed directly together for a DIRECT output and applied to the voltage controlled filter, mode filters and resonators.

1.9 FILTERING AND OUTPUT SECTIONS

The filtering and output sections are contained on the voltage controlled filter and keyboard circuit board (TR) and fixed and variable resonant filter board (TC).

The TR circuit board contains three main circuit functions: (1) the voltage controlled filter with associated functions; (2) output drive and swell (loudness) control; and (3) the monophonic keyboard system.

The voltage controlled filter has four sections with emphasis control and employs the patented Moog transistor ladder. The functions associated with this voltage controlled filter include the contour generator, sample and hold, triangular modulation, cutoff frequency, amount of keyboard feed and emphasis. As indicated in Volume II, a number of Polymoog functions are applied on a split keyboard basis. In particular, the audio signal applied to the voltage controlled filter may be derived from the bottom two octaves or the top four octaves via the lower-upper select circuitry controlled from KEYBOARD LOWER-UPPER pushbutton switches and their associated latches. After lower-upper selection, the gain of the VCF audio path is normalized by VCF gain select resistors since the level of the audio signals coming from the modulator/generator mother boards will vary from preset to preset. Emphasis or Q control of the filter is accomplished by using a CA3080 integrated circuit as a variable gain feedback element to the transistor ladder.

Contour generator operation consists of an initial attack, followed by an initial decay to a prescribed sustain level, followed by a final decay. If the final decay (foot sustain) for the polyphonic system is on (LOCK pushbutton depressed), the final decay for the filter contour generator will also be on and vice versa. The contour generator utilizes a LM555 integrated circuit as a basic control element and a CA3080 integrated circuit as a remotely controlled current device which charges or discharges an integrating capacitor at rates determined by currents provided by the front panel control assembly. Attack and decay currents are switched back and forth to the CA3080 using CMOS switches, depending upon whether the contour is in the attack or decay phase. The sustain level is a voltage derived from the front panel control current which sets an equilibrium point for the contour generator during the initial decay phase. That is, the contour initially attacks, then seeks the variable sustain level at the variable decay rate. When a key is raised, the sustain or equilibrium value is returned to zero and the contour generator seeks zero at the decay rate if the polyphonic final decay function is on. If the polyphonic final decay is not on, the contour generator integrating capacitor output is rapidly pulled toward ground via a diode connected to logic circuitry driven from the final decay circuit.

Each time a key is depressed, a filter contour is initiated. A sensing resistor is connected to each drive point of the polyphonic keyboard RC network and these resistors are commonly connected to a trigger amplifier which sums currents provided via the lowest level drive buss. A d-c trigger detector determines whether this total current exceeds a minimum value and if it does, the detector generates a d-c trigger signal. As successive keys are depressed on the keyboard, the trigger amplifier output voltage changes in steps and the a-c trigger detector generates a 5 msec pulse. Single or multiple triggering, selected by the TRIG MODE ON-OFF switch, is available at the S-TRIG OUT jack on the rear panel. In the multiple trigger mode, the contour generator will re-attack at the maximum level of the attack rate whenever successive keys are depressed. Note that the trigger signal is derived from the polyphonic keyboard system.

The monophonic keyboard system on the TR board is comprised of two resistor strings, one for the lower two octaves and one for the upper four octaves. Whenever a key is depressed, a tap at the appropriate point in the resistor string is connected to the monophonic keyboard buss. Either the lower or upper resistor string (but not both simultaneously) has a constant current source applied to generate a constant voltage interval between successive notes of approximately 0.5 volt.

The VCF KEYBOARD LOWER-UPPER audio select pushbutton switches also determine whether the lower or upper resistor string is active (connected to a current source). The two resistor strings are connected to a common current source device which employs diode isolation. When one resistor string is active, the other string is floating between reverse biased diodes. This diode isolation is used to prevent loading of the upper resistor string by the lower resistor string if the VCF is in the upper mode and keys are depressed simultaneously on both the upper four octaves and lower two octaves. Loading could occur if isolation was not used because a common keyboard buss is used for all six octaves.

The upper keyboard resistor string has a fixed voltage applied to the top and a current sink applied to the bottom resulting in high note priority. When the lower keyboard resistor string is activated, a fixed voltage is applied to the bottom of the resistor string and a current source is applied to the top of the string resulting in a low note priority.

The monophonic and polyphonic keyboard contacts associated with each key are arranged so that the monophonic buss contact closes first. As mentioned previously, a 5 msec trigger derived from the polyphonic keyboard section drives a sample and hold circuit using a CD4016 CMOS switch. The voltage on the keyboard sample and hold capacitor is buffered by a high impedance follower, followed by a CA3080 integrated circuit used as a remote controlled current source, a second capacitor and a second buffer amplifier whose output is returned as the feedback reference to the initial buffer amplifier. The CA3080 integrated circuit current source is controlled by the front panel EXT KB GLIDE control.

The a-c trigger is used instead of the d-c trigger to acquire keyboard voltage so that new keyboard voltages are acquired only when a new key is depressed. This type of keyboard sampling, for example, prevents jump down of the monophonic keyboard signal as notes of a chord are released.

The monophonic keyboard voltage is applied to the external KB OUT connector via a CMOS isolation gate and also to the keyboard amount voltage controlled amplifier. The EXT SYN ON-OFF switch input controls the external KB OUT and S-TRIG OUT signals.

The keyboard amount VCA is comprised of a CA3080 integrated circuit used as a variable gain amplifier, whose output is applied to the input of the filter current source along with the output of the contour amount VCA, sample and hold amount VCA, external filter cutoff input and modulation amount VCA. All of these inputs are summed and applied to an NPN/PNP current source. The contour, modulation, and sample and hold amount VCAs all use CA308 integrated circuits as current controlled variable gain amplifiers.

The modulation oscillator is identical to that described for the frequency modulation oscillators. The square wave output from the filter modulation oscillator is differentiated and applied to a sample and hold gate utilizing a CA3080 integrated circuit. This sample and hold gate samples the output of a filtered noise source and applies its output to the sample and hold amount VCA.

The direct OUTH, OUTM and OUTL outputs from the high, medium and low mother boards are summed and applied to the DIRECT master gain control on the front panel. The return direct signal is applied directly to the summing and drive amplifier, as are the VCF, (RESONATOR) and MODE (preset) outputs and the AUX input from the rear panel. In addition to driving the summing and drive amplifier, the DIRECT, VCF, RESONATOR and MODE (pre) signals are a-c coupled directly to rear panel output connectors. The summing and drive amplifier combines these signals and drives a 600-ohm balance line mix output connected to a BAL MIX (XLR) connector on the rear panel. The gain of this amplifier is determined by the SWELL input controlled by a LED photocell attenuator to provide remote loudness control.

The TC circuit board contains eight mode (preset) filters and three variable gain, cutoff frequency and Q state variable filters. Outputs from the modulator/generator mother boards pass through select gates which determine whether filters on the TC board are driven by the bottom two octaves or the top four octaves or all six octaves combined. Signals from the selected mother boards are applied to drive amplifiers which drive balance resistors to compensate for signal level differences of different presets. In addition, these drive amplifier signals are summed by another drive amplifier which in turn drives the resonators (Q state variable filters).

The balance resistors convert audio drive amplifier voltages to eight different scaled currents. The current level appropriate for a particular preset is routed through the preset gain select and eight-to-one analog switch multiplexer driven by the binary encoded preset number. The selected current is applied to a gain recovery amplifier which drives eight master preset fixed filters in parallel. The outputs of the eight fixed filters are applied to the inputs of a second eight-to-one analog switch multiplexer driven again by the binary coded preset number. The output of this second selector is applied directly to the MODE master gain control on the front panel whose output is returned to the summing and drive amplifier on the TR board.

The output of the drive amplifier for the RESONATORS is applied to three (LOW, MED and HIGH) front panel RESONATOR GAIN controls. The outputs from these GAIN controls are returned to the TC board and applied to the inputs of three filters covering the frequency ranges of 50 to 300 Hz, 300 to 1500 Hz and 1500 to 7500 Hz. Each of these Q state variable filters has independent lowpass, bandpass and highpass outputs. The corresponding sections of each filter are summed together via isolation resistors and applied to an analog CMOS selector switch driven by the HIGH-LOW-BAND selector switch on the front panel. The output of this analog selector switch is applied to a drive amplifier supplying the master GAIN control for the RESONATOR section. The output from this GAIN control wiper arm is returned to the summing and drive amplifier on the TR board.

In summary, the Polymoog has five output channels: (1) DIRECT, unfiltered sum of three mother board outputs; (2) VCF, voltage controlled filter output; (3) RES, resonators output; (4) PRE, mode (preset) filter output; and (5) MIX, sum of (1) through (4) and the AUX input.

1.10 OSCILLATOR RANKS (Refer to Figure 1-4)

The oscillator ranks are physically located on the divider board assembly and consist of two independent frequency divider chains, one for the sawtooth rank and one for the rectangular rank and two high frequency oscillator plug-in boards, each providing the twelve top notes of each oscillator rank.

The two phase comparator outputs from the TL board are applied to the high frequency oscillator boards to drive lowpass filters, high frequency voltage controlled oscillators and drivers which in turn drive the top octave synthesizers. The top octave synthesizer outputs are applied to the frequency dividers and two outputs from each of the divider ranks are fed back to the high frequency oscillator boards for octave select. When the FOOTAGE controls for a particular oscillator rank are changed on the front panel, one of the divider return frequencies is selected via the octave select gates and returned to the phase comparator on the TL board. This phase comparator compares the returned frequency with the reference frequency from the precision low frequency on the TL board and provides a correction signal to the lowpass filter if the two frequencies do not match exactly. Thus, octave selection is accomplished by forcing the phase lock loop to compensate for a change in the selected return frequency. The outputs of the divider are applied directly to the modulator/generator mother boards via connectors.

1.11 POLYMOOG AND POLYMOOG KEYBOARD PRELIMINARY CHECK

Prior to disassembly, perform the following checks.

a. Make certain that the 110/220 VAC power selector switch on the left side of the rear panel is in the proper position before turning the instrument on.

b. Visually inspect power cord for possible damage.

c. Make certain instrument is connected and operated according to Owners Manual. If possible, check associated equipment such as cables, jacks, amplifier or audio monitor used with the unit for proper operation. Headphones may be plugged directly into the MIX (MAIN on Polymoog Keyboard) output connector to check the audio monitor.

d. Ascertain +5 VDC power supply is operating by observing illumination of red indicator lights (LEDs) adjacent to pushbutton switches and the numeric display at the center of instrument.

e. Connect monitor system to MIX (MAIN on Polymoog Keyboard) output connector, select preset 1, raise DIRECT master gain control (Volume on Polymoog Keyboard) and depress key. If instrument is not operating properly at this point, proceed with disassembly.

1.12 DISASSEMBLY

a. Disconnect power cord connector and all other rear panel connections.

b. Remove four screws securing cover to rear panel extrusion using a medium sized Phillips head screwdriver.

c. Loosen two captive knurled thumb screws under the instrument extreme front left and right sides until they turn freely and lift cover directly up.

d. Reconnect power cable and audio signal monitor.

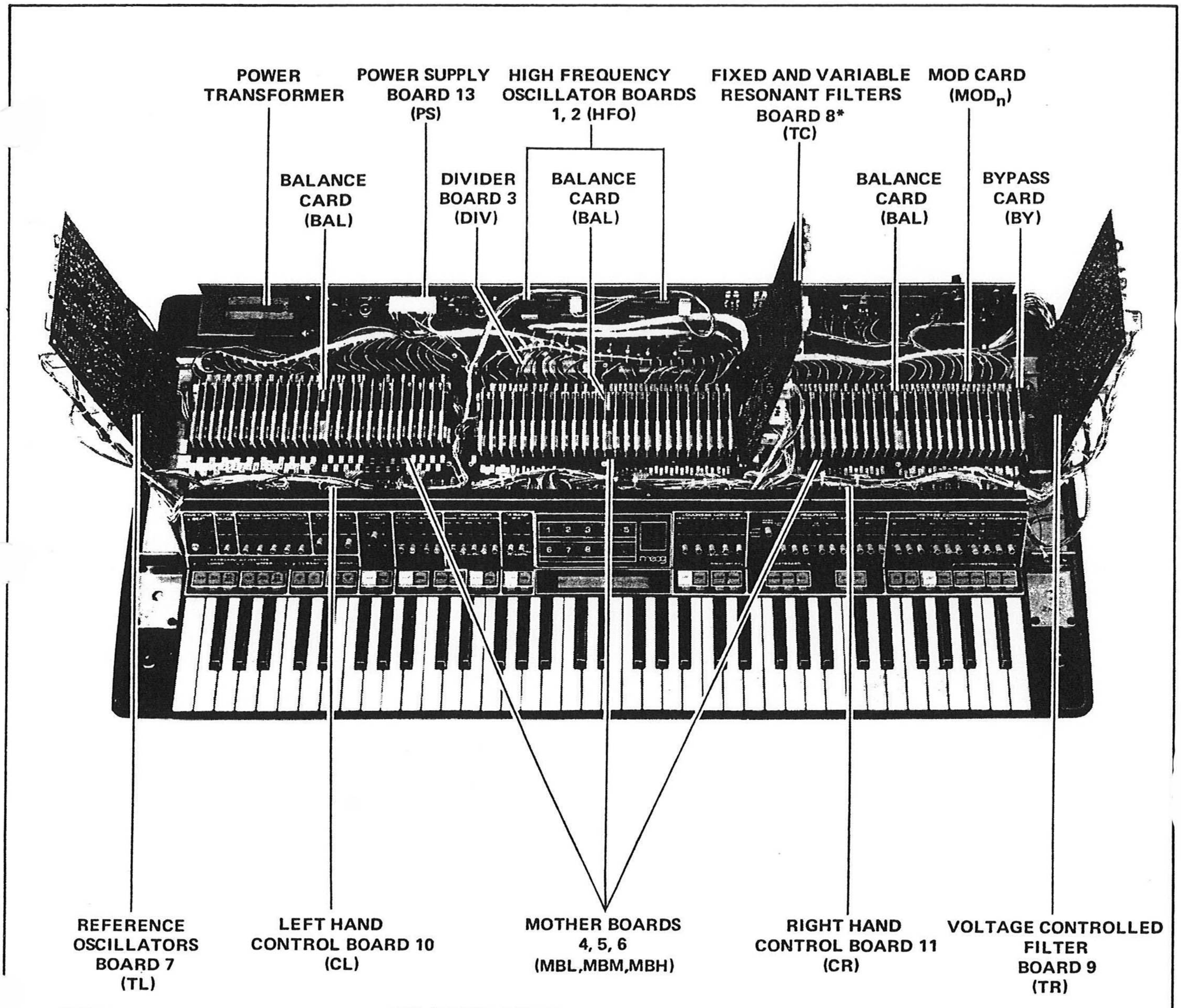
> **NOTE**
>
> All internal alignment and adjustment controls are now accessible. Refer to Table 1-1 for the location of all printed circuit board assemblies.

1.13 VISUAL INSPECTION

a. Inspect unit for broken wires, damaged or missing components and other obvious defects.

b. Check that all electrical connectors and printed circuit board assemblies are properly located as shown in Figures 1-5 and 1-6 and inserted into their respective connectors.

c. Examine wiring harness and connections to front panel for loose or poorly soldered terminations.


POWER TRANSFORMER
POWER SUPPLY BOARD 13 (PS)
HIGH FREQUENCY OSCILLATOR BOARDS 1, 2 (HFO)
FIXED AND VARIABLE RESONANT FILTERS BOARD 8* (TC)
MOD CARD (MOD_n)
BALANCE CARD (BAL)
DIVIDER BOARD 3 (DIV)
BALANCE CARD (BAL)
BALANCE CARD (BAL)
BYPASS CARD (BY)
REFERENCE OSCILLATORS BOARD 7 (TL)
LEFT HAND CONTROL BOARD 10 (CL)
MOTHER BOARDS 4, 5, 6 (MBL,MBM,MBH)
RIGHT HAND CONTROL BOARD 11 (CR)
VOLTAGE CONTROLLED FILTER BOARD 9 (TR)

* BOARD 8 CONTAINS 8 FILTER BOARDS: BOARD 1 STRING FILTER, 2 PIANO FILTER, 3 ORGAN FILTER, 4 HARPSICHORD, 5 FUNK, 6 CLAVINET, 7 VIBES, 8 MODE FOR BRASS.

FIGURE 1-5 POLYMOOG PRINTED CIRCUIT BOARD LOCATION

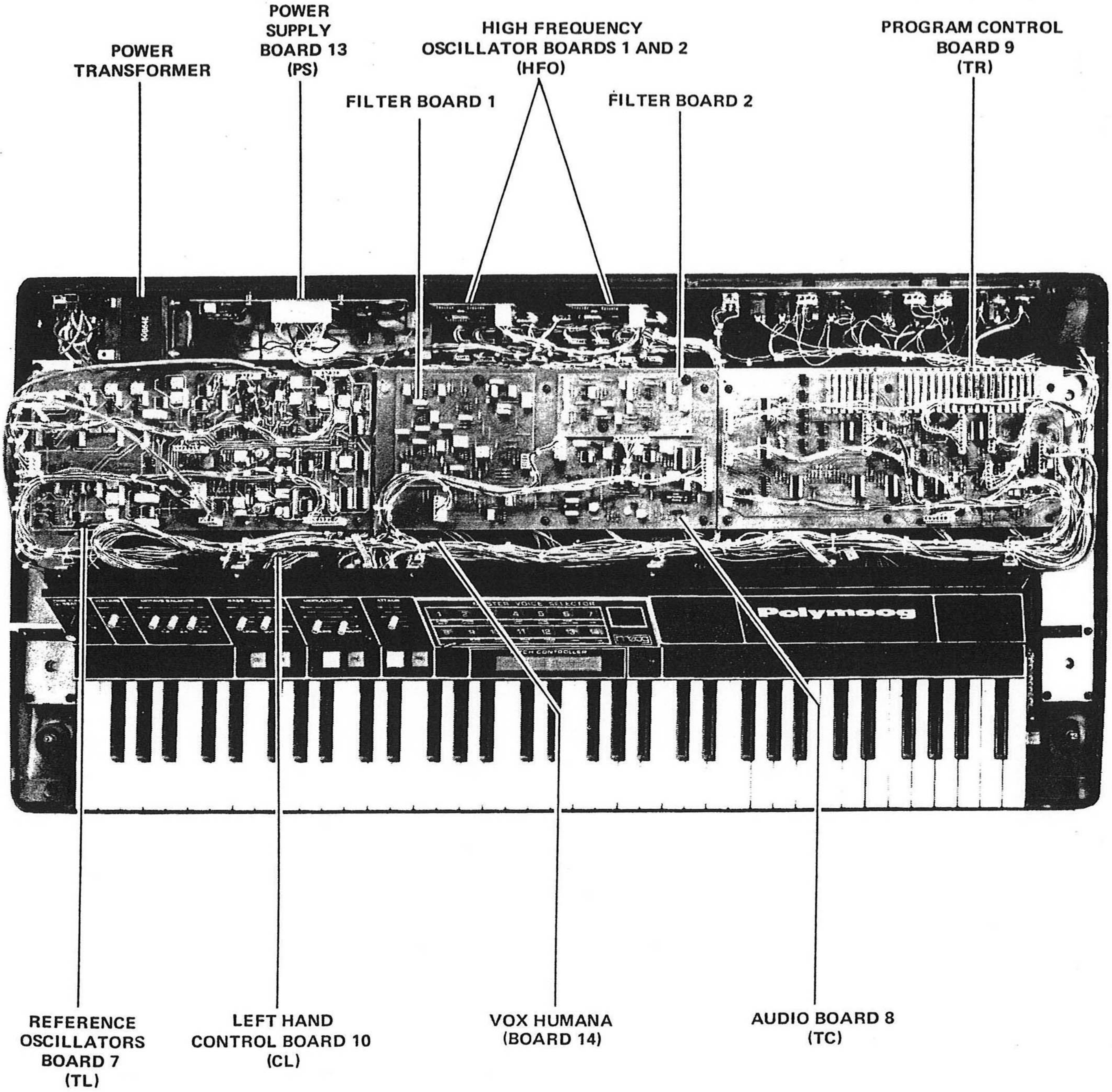

POWER TRANSFORMER
POWER SUPPLY BOARD 13 (PS)
FILTER BOARD 1
HIGH FREQUENCY OSCILLATOR BOARDS 1 AND 2 (HFO)
FILTER BOARD 2
PROGRAM CONTROL BOARD 9 (TR)
Polymoog
REFERENCE OSCILLATORS BOARD 7 (TL)
LEFT HAND CONTROL BOARD 10 (CL)
VOX HUMANA (BOARD 14)
AUDIO BOARD 8 (TC)

FIGURE 1-6 POLYMOOG KEYBOARD PRINTED CIRCUIT BOARD LOCATION

1 2 3 4 5 6 7 14
8 9 10 11 12 13 14

1.14 POLYMOOG AND POLYMOOG KEYBOARD TEST, TROUBLESHOOTING AND ADJUSTMENT

The basic approach to troubleshooting is to locate which printed circuit board or subassembly is malfunctioning. If a problem is located on a particular printed circuit board and corrected, it will not be necessary to adjust any internal controls, with the possible exception of the board on which the malfunction occurred. If necessary, the controls on each printed circuit board can be aligned separately.

1.15 TEST EQUIPMENT

The following electronic test equipment is recommended for complete servicing and alignment:

a. Digital voltmeter, minimum 3-1/2 digits with millivolt resolution.

b. Oscilloscope, minimum 5 mHz frequency response and 10 millivolt sensitivity.

c. AC voltmeter for audio frequencies, minimum 10 millivolt full scale sensitivity on low scale.

d. Audio oscillator, 20 to 20kHz frequency range.

1.16 TROUBLESHOOTING

In all cases of troubleshooting and alignment, the power supply assembly output voltages must be checked first and adjusted if necessary. Table 8-1 provides a procedure for determining whether the power supply itself is operating properly or, if a supply voltage cannot be obtained, locating the malfunctioning printed circuit board. The +15, -15 and +5 VDC outputs (see Figure 8-3) are set to their nominal values within 10 millivolts. The most common anticipated problem related to the power supply assembly is failure of the supply itself or shorts within the distribution network.

A shorted power supply voltage is usually caused by a defective semiconductor such as an integrated circuit, diode or transistor. Normally, this type of short results in the malfunctioning component getting hot, and if a short has been traced to a specific board, a defective component can be located by simply finger touching the components with power applied to the board.

In many cases, the printed circuit board or assembly location of a malfunction will be obviou from the nature of the problem. In Volume II th detailed block diagram will serve as a basic guid for determining the malfunctioning printed circuit board. For example, if the voltage controlled filter is working properly, but the filter modulation is not, then either the problem is in the front panel control assembly or on the TR board itself. Again, it should be emphasized that the primary goal at this point is to locate the board or subassembly which is malfunctioning. Tables 1-3 and 1-5 and Figures 1-7 and 1-8 correlate front panel controls and rear panel connectors with a printed circuit board or subassembly. When a malfunction is identified as associated with one of these controls, the most likely board location for the difficulty can usually be determined from this table and figure. Table 1-4 contains a list of possible malfunctions along with the most probable associated malfunctioning printed circuit board. Once the location of the difficulty has been associated with a particular board or subassembly, proceed to the troubleshooting section for that particular assembly.

> **NOTE**
>
> The Polymoog and Polymoog Keyboard have been designed with a large number of internal connectors provided primarily for serviceability. The system may be powered up with any of the boards disconnected without resultant damage.

TABLE 1-3

POLYMOOG OPERATING CONTROLS AND INDICATORS

FIGURE 1-7 INDEX NO.	PANEL MARKING	REF DESIG	ASSOCIATED PRINTED CIRCUIT BOARD	FUNCTION
1	FINE TUNE	R105	TL	Tunes entire instrument ±2 semitones.
2	BEAT	R107	TL	Tunes oscillator to rank No. 1, 2 semitones.
3	EXT KB GLIDE (Black)	R63	TR	Adjusts amount of glide of monophonic keyboard circuit.
4	MASTER GAIN CONTROLS			
	AUX (Red)	R180	TR	Sets output level of external signal applied to AUX input connector (30).
	DIRECT (Red)	R3	TR	Sets output level of Polymoog direct channe
	MODE (Red)	R1	TC, TR	Sets output level of Polymoog mode channe
	RES (Red)	R2	TC,TR	Sets output level of Polymoog resonator channel.
	VCF (Red)	R179	TR	Sets output level of Polymoog voltage controlled filter channel.
5	OCTAVE BAL			
	1-2 (Black)	R65	MBL	Adjusts audio signal drive level for lowest two octaves of all output channels.
	3-4 (Black)	R66	MBM	Adjusts audio signal drive level for middle two octaves of all output channels.
	5-6 (Black)	R67	MBH	Adjusts audio signal drive level for upper two octaves of all output channels.
6	/\/\/ RANK TUNE (Black)	R20	TL,CL	Tunes sawtooth rank plus or minus a musical sixth.
	VAR - PRE	SW11,SW12	CL,TL	Pushbuttons select either variable or preset mode for sawtooth rank tuning. Illuminated LED identifies selection.
7	/\/\/ FM			
	RATE (Green)	R26	TL,CL	Sets frequency modulation rate of sawtooth oscillator.
	AMT (Yellow)	R41	TL,CL	Determines amount of sawtooth frequency modulation.
	VAR - PRE	SW13,SW14	CL,TL	Pushbuttons select either variable or preset mode of frequency and/or phase modulation. Illuminated LED identifies selection.

TABLE 1-3

POLYMOOG OPERATING CONTROLS AND INDICATORS (Continued)

FIGURE 1-7 INDEX NO.	PANEL MARKING	REF DESIG	ASSOCIATED PRINTED CIRCUIT BOARD	FUNCTION
8	⎍⎍ FM/PM			
	RATE (Green)	R29	TL,CL	Sets frequency rate of rectangular frequency modulation.
	AMT (Yellow)	R43	TL,CL	Determines amount of rectangular rank frequency modulation.
	FREE - LOCK	SW20,SW19	CL,TL	Pushbuttons select either free or lock mode of two oscillator ranks. Illuminated LED identifies selection.
9	⎍⎍ SHAPE/ MODULATION			
	LOWER KEYBOARD SHAPE (Black)	R46	TL,CL	Varies rectangular pulse width of lowest two octaves from 5 to 50 percent.
	LOWER KEYBOARD AMT (Yellow)	R49	TL,CL	Sets amount of pulse width modulation for lowest two octaves.
	UPPER KEYBOARD SHAPE (Black)	R51	TL,CL	Varies rectangular pulse width of upper four octaves from 5 to 50 percent.
	UPPER KEYBOARD AMT (Yellow)	R53	TL,CL	Sets amount of pulse width modulation for upper four octaves.
	KEYBOARD RATE (Green)	R57	TL,CL	Determines frequency rate of pulse width modulation for all octaves.
	VAR - PRE	SW17,SW18	CL,TL	Pushbuttons select either variable or preset mode for rectangular shape and modulation. Illuminated LED identifies selection.
10	⊿⊿ RANK MIX			
	LOWER KEYBOARD (Black)	R34	TL,CL	Sets sawtooth level of lower two octaves.
	UPPER KEYBOARD (Black)	R45	TL,CL	Sets sawtooth level of upper four octaves.
	VAR - PRE	SW15,SW16	CL,TL	Pushbuttons select either variable or preset mode of sawtooth rank mix levels. Illuminated LED identifies selection.

TABLE 1-3
POLYMOOG OPERATING CONTROLS AND INDICATORS (Continued)

FIGURE 1-7 INDEX NO.	PANEL MARKING	REF DESIG	ASSOCIATED PRINTED CIRCUIT BOARD	FUNCTION
11	Mode Selector Control Panel		PRE,CR	
	1 thru 8	SW1 thru SW8		Pushbuttons select one of eight basic preset operating modes (string, piano, organ, harpsicord, funk, clavinet, vibes or brass).
	9	SW9		Pushbutton places entire instrument into a variable mode.
		SW10		Lamp lit defeats canceling action (return to preselection state) when a mode 1 thru 8 pushbutton is depressed.
12	PITCH CONTROLLER	R62	TL,CR	Varies pitch of entire instrument plus or minus a musical sixth.
13	Digital Display	L1	PRE,CR	Displays basic preset operating mode selected by mode selector control panel pushbutton.
14	LOUDNESS CONTOUR			
	KB DYN (Black)	R47	TL,CR	Determines amount of dynamic keyboard effect.
	ATTACK (Black)	R53	TL,CR	Determines attack rate if sustain level is raised.
	LOWER KEYBOARD D/R (Black)	R51	TL,CR	Adjusts initial and final decay rates of lower two octaves to the sustain level.
	UPPER KEYBOARD D/R (Black)	R49	TL,CR	Adjusts initial and final decay rates of upper four octaves to the sustain level.
	SUSTAIN (Black)	R55	TL,CR	Determines sustain level while key is depressed.
	VAR - PRE	SW16,SW17	CR,TL	Pushbuttons select either variable or preset mode for loudness contour control. Illuminated LED identifies selection.
	FINAL DECAY LOCK - MAN	SW14,SW15	CR,TR	Depressing LOCK pushbutton selects final decay unconditionally ON, while depressing MAN pushbutton allows foot pedal control of final decay. Illuminated LED identifies selection.

TABLE 1-3

POLYMOOG OPERATING CONTROLS AND INDICATORS (Continued)

FIGURE 1-7 INDEX NO.	PANEL MARKING	REF DESIG	ASSOCIATED PRINTED CIRCUIT BOARD	FUNCTION
15	RESONATORS			
	PASS MODE LOW-BAND-HIGH	SW1	TC	Selects either low band or high pass mode for low, medium and high resonators simultaneously.
	LOW CF (Black)	R60	TC	Adjusts cutoff frequency of low resonator between 60 and 300Hz.
	LOW EMPH (Black)	R59	TC	Sets emphasis (Q) of low resonator.
	LOW GAIN (Red)	R58	TC	Determines gain of low resonator.
	MED CF (Black)	R70	TC	Adjusts cutoff frequency of medium resonator between 300 and 1500Hz.
	MED EMPH (Black)	R69	TC	Sets emphasis (Q) of medium resonator.
	MED GAIN (Red)	R68	TC	Determines gain of medium resonator.
	HIGH CF (Black)	R82	TC	Adjusts cutoff frequency of high resonator between 1.5 and 7.5KHz.
	HIGH EMPH (Black)	R81	TC	Sets emphasis (Q) of high resonator.
	HIGH GAIN (Red)	R80	TC	Determines gain of high resonator.
	KEYBOARD LOWER-UPPER-ALL	SW11, SW10, SW9	TC,CR	Selected pushbutton determines whether resonator inputs are applied from the lower two octaves, upper four octaves or all octaves. Illuminated LED identifies selection.
	ON-OFF	SW12,SW13	TC,CR	Pushbuttons select whether resonator audio channel is on or off. Illuminated LED identifies selection.
16	VOLTAGE CONTROLLED FILTER			
	CUTOFF (Black)	R9	TR,CR	Varies cutoff frequency of voltage controlled filter.

TABLE 1-3

POLYMOOG OPERATING CONTROLS AND INDICATORS (Continued)

FIGURE 1-7 INDEX NO.	PANEL MARKING	REF DESIG	ASSOCIATED PRINTED CIRCUIT BOARD	FUNCTION
16 cont.	EMPH (Black)	R11	TR,CR	Sets emphasis (Q) of voltage controlled filter.
	KB (Black)	R42	TR,CR	Determines amount of monophonic keyboard buss voltage applied to voltage controlled filter.
	MODULATION RATE (Green)	R7	TR,CR	Sets frequency rate of voltage controlled filter modulation oscillator and sample and hold circuits.
	MODULATION AMT (Yellow)	R13	TR,CR	Determines amount of repetitive voltage voltage controlled filter modulation.
	MODULATION S & H (Black)	R5	TR,CR	Adjusts amount of sample and hold modulation of the cutoff frequency.
	CONTOUR AMT (Yellow)	R21	TR,CR	Sets amount of filter contour.
	CONTOUR ATTACK (Black)	R17	TR,CR	Determines attack rate of filter contour.
	CONTOUR DECAY (Black)	R19	TR,CR	Selects initial and final decay of filter contour.
	CONTOUR SUSTAIN (Black)	R15	TR,CR	Determines sustain level of filter contour while key is held.
	ON-OFF	SW3,SW4	TR,CR	Pushbuttons select whether voltage controlled filter audio channel is on or off. Illuminated LED identifies selection.
	VAR - PRE	SW16,SW17	CR,TR	Pushbuttons select either variable or preset mode for voltage controlled filter parameters. Illuminated LED identifies selection.
	KEYBOARD LOWER-UPPER	SW5,SW6	CR,TR	Pushbuttons determine whether monophonic keyboard voltage is derived from lower two octaves or upper four octaves. Illuminated LED identifies selection.
	KEYBOARD ALL-SPLIT	SW7,SW8	CR,TR	Pushbuttons determine if audio feed to voltage controlled filter is from entire keyboard or if it is determined by the KEYBOARD LOWER-UPPER pushbuttons. Illuminated LED identifies selection.

TABLE 1-3

POLYMOOG OPERATING CONTROLS AND INDICATORS (Continued)

FIGURE 1-7 INDEX NO.	PANEL MARKING	REF DESIG	ASSOCIATED PRINTED CIRCUIT BOARD	FUNCTION
17	Keyboard		KB	Provides 71 musical note responses for polyphonic or monophonic control of the instrument.
18	FOOTAGE			
	/|/| RANK 8′ - 4′	SW7,SW8	CL,TOS,TL	Pushbutton selects sawtooth rank oscillator frequency of 8′ or 4′. Illuminated LED identifies selection.
	⎍⎍ RANK 16′ - 8′	SW9,SW10	CL,TOS,TL	Pushbutton selects sawtooth rank oscillator frequency of 16′ or 8′. Illuminated LED identifies selection.
19	KEYBOARD WAVESHAPE			
	LOWER	SW1,SW2, SW3	CL,TL	Pushbuttons select sawtooth, rectangular or both waveshapes for the lower two octaves. Illuminated LED identifies selection.
	UPPER	SW4,SW5, SW6	CL,TL	Pushbuttons select sawtooth, rectangular or both waveshapes for the upper four octaves. Illuminated LED identifies selection.
20	BEAT	L1	TL	Displays difference between reference high frequency oscillator beat rates.
21	S-TRIG OUT	P1	TR	Provides single or multiple trigger output determined by TRIG MODE selector switch (26).
22	KB OUT	J4	TR	Provides monphonic keyboard control voltage output for controlling an external synthesizer.
23	KB SCALE	R1	TR	Adjusts keyboard output voltage range.
24	MOD AMT	J17	TR	Input controls amount of frequency and pulse width modulation when appropriate front panel controls are in the VAR mode.
25	EXT SYN ON-OFF	J2	TR	Switch ON-OFF input controls outputs of S-TRIG OUT and KB OUT connectors (21 and 22).

TABLE 1-3

POLYMOOG OPERATING CONTROLS AND INDICATORS (Continued)

FIGURE 1-7 INDEX NO.	PANEL MARKING	REF DESIG	ASSOCIATED PRINTED CIRCUIT BOARD	FUNCTION
26	TRIG MODE ON-OFF	J13	TR	Switch ON-OFF input determines single or multiple trigger mode at S-TRIG OUT connector (21).
27	BAL MIX (Output)	S2	TR	Provides XLR balanced line 600-ohm output.
28	MIX (Output)	J10	TR	Supplies single ended mix output derived from BAL MIX connector (27); insertion of jack automatically unbalances BAL MIX output to provide single ended output.
29	PRE (Output) Serial No. 1 thru 1600 MODE (Output) Serial No. 1601 and Subsequent	J8	TC,TR	Provides internal fixed filter mode channel output.
30	AUX (Input)	J9	TR	Provides an input for an external audio signal controlled by AUX master gain control on front panel; output appears at MIX connector (28).
31	VCF (Input)	J15	TR	Presents an input directly to voltage controlled filter. Output appears at VCF and MIX output connectors (36 and 28).
32	ACCESSORIES 1 and 2	S3,S4	PS	Provides +15, -15 and +5 VDC outputs for accessories.
33	RES (Input)	J16	TC,TR	Provides direct input to resonators; output appears at RES and MIX output connectors (34 and 28).
34	RES (Output)	J14	TC,TR	Provides resonator channel output.
35	DIRECT (Output)	J7	TC,TR	Provides direct channel output.
36	VCF (Output)	J6	TR	Provides voltage controlled filter channel output.
37	GLIDE ON-OFF	J5	TR	Switch ON-OFF input activates front panel EXT KB GLIDE control (3).

TABLE 1-3
POLYMOOG OPERATING CONTROLS AND INDICATORS (Continued)

FIGURE 1-7 INDEX NO.	PANEL MARKING	REF DESIG	ASSOCIATED PRINTED CIRCUIT BOARD	FUNCTION
38	SUSTAIN ON-OFF	J1	TR	Switch ON-OFF input controls final decay when front panel FINAL DECAY MAN pushbutton is depressed.
39	PITCH	J12	TR	Input varies frequency of high frequency oscillators; jack tip controls both oscillators simultaneously, stereo ring controls frequency of rectangular rank separately.
40	FILTER	J3	TR	Input varies the voltage controlled filter cutoff frequency.
41	SWELL	J11	TR	Input controls output level at BAL MIX and MIX connectors (27 and 28).
42	S-TRIG IN	S1	TR	Provides S-trigger input connection for filter contour.

TABLE 1-4
POLYMOOG AND POLYMOOG KEYBOARD TROUBLESHOOTING CHART

MALFUNCTION	ASSOCIATED PRINTED CIRCUIT BOARD
Thumps on n^{th} note	MOD_n
Noise on n^{th} note	MOD_n
No sawtooth or pulse on n^{th} note	MOD_n
Dead n^{th} note only	MOD_n, KB
Numeric display poor	MODE, CR, MASTER VOICE SELECTOR
Preset pushbutton inoperative	MODE, CR, MASTER VOICE SELECTOR
Keyboard pushbuttons inoperative (Polymoog only)	CR Or CL
Preset voice poor, variable function present (Polymoog only)	CR Or CL

TABLE 1-5

POLYMOOG KEYBOARD OPERATING CONTROLS AND INDICATORS

FIGURE 1-8 INDEX NO.	PANEL MARKING	REF DESIG	ASSOCIATED PRINTED CIRCUIT BOARD	FUNCTION
1	FINE TUNE	R105	TL	Tunes Polymoog Keyboard to another instrument such as piano or organ.
2	BEAT	R107	TL	On presets using two oscillators, controls differences in pitch between two oscillators.
3	VOLUME	R56	LPC	Master output level control.
4	OCTAVE BALANCE			
	1-2	R19	MBL	Adjusts audio signal drive level for lowest two octaves of all output channels.
	3-4	R20	MBM	Adjusts audio signal drive level for middle two octaves of all output channels.
	5-6	R21	MBH	Adjusts audio signal drive level for upper two octaves of all output channels.
5	BASS FILTER	J8	TC	Takes signal from lower keyboard at left of dot and sends it through a low-pass filter which cuts off high frequencies.
6	LEVEL	R55	TC	Bass filter volume control.
7	CUT-FREQ	R54	TC	Varies cut-off frequency of low pass filter.
8	ON-OFF	SW3, SW4	TC	Pushbuttons remove or add low pass filter.
9	MODULATION		TL	Introduces repetitive vibrator on waveform changes.
10	RATE	R106	TL	Sets frequency rate of voltage controlled oscillator.
11	AMOUNT	R108	TL	Voltage control of modulation frequency and pulse width when panel controls are in variable mode.
12	VAR, PRE	SW5, SW6	TL	Pushbuttons select either variable or preset modes of modulation.
13	ATTACK	R109	CL	This is the amountof time between striking a key and reaching maximum volume.

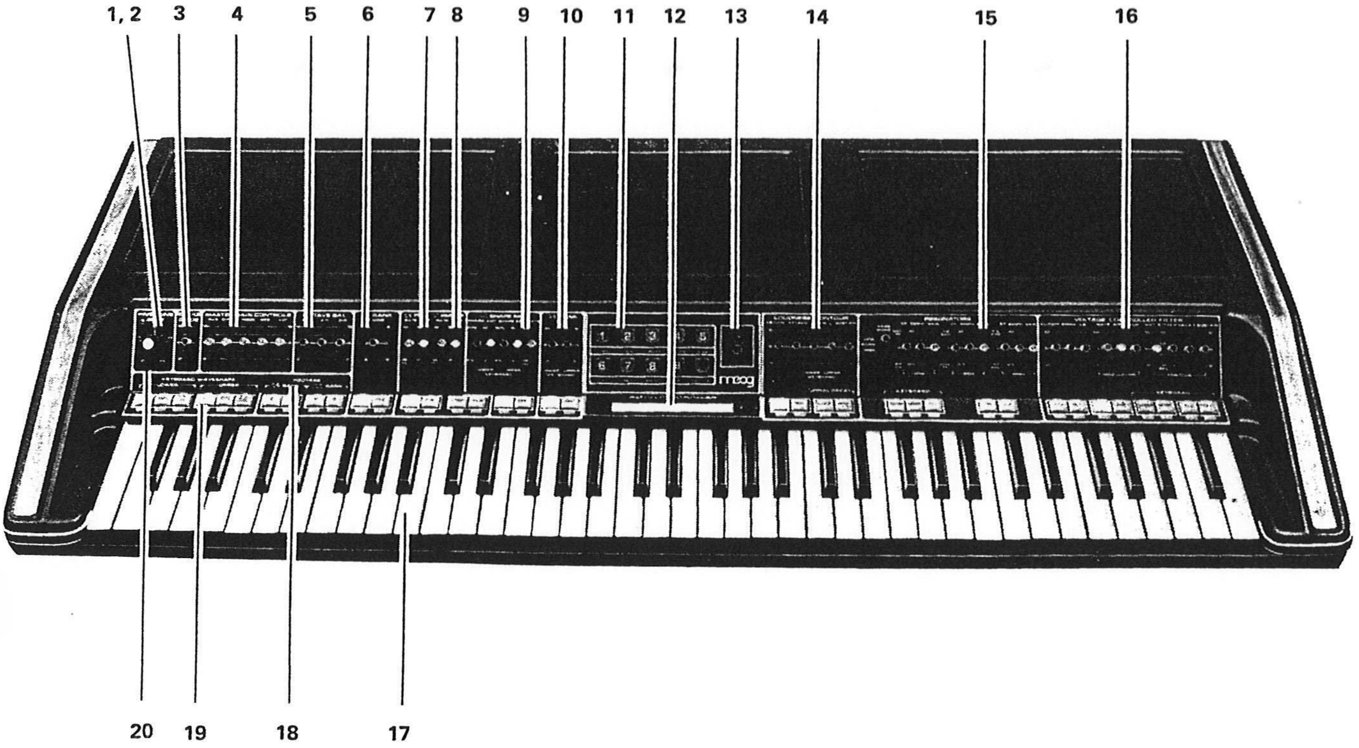
TABLE 1-5
POLYMOOG KEYBOARD OPERATING CONTROLS AND INDICATORS (Continued)

FIGURE 1-8 INDEX NO.	PANEL MARKING	REF DESIG	ASSOCIATED PRINTED CIRCUIT BOARD	FUNCTION
14	VAR, PRE	SW1, SW2	CL	Pushbuttons select either variable or preset modes for attack.
15	MASTER VOICE SELECTOR		TC	Permits reproduction of a selected instrument.
16	S-TRIG OUT	P1	TR	Provides for multiple or simgle trigger output supplied by SINGLE or MULT switch SW1.
17	FOOT SWITCH	J3	TR	Provides for connection to Polypedal SINGLE/MULT trigger switch.
18	KB SCALE	R110	TR	Adjusts volts per octave of keyboard control voltage output.
19	KB RANGE	R111	TR	Centers keyboard output voltage.
20	DIRECT OUT	J6	TC	Provides bass filter output.
21	SWELL	J7	TC	Provides for connection to Polypedal controller SWELL circuit.
22	GLIDE	R112	TR	Adjusts Portamento time duration of keyboard output voltage.
23	FILTER	J8	TC	Input varies voltage controlled filter cutoff frequency.
24	PITCH	J11	TL	Input varies frequency of high frequency oscillators.
25	DC ACCESSORY POWER	S1	PS	Provides +5, ± 15VDC, 50mA power for accessories.
26	MOD AMOUNT	J1	TR	Input controls amount of frequency and pulse width modulation, when appropriate front panel controls are in the VAR mode.
27	GLIDE ON/OFF	J5	TR	Input provides for external switch to activate glide circuit.

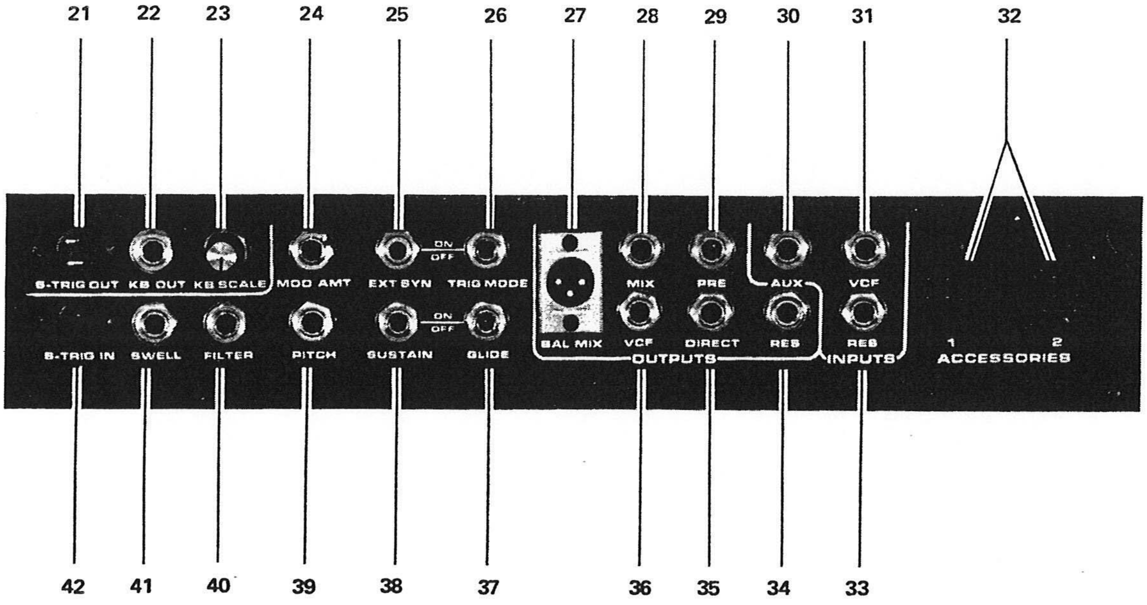
TABLE 1-5
POLYMOOG KEYBOARD OPERATING CONTROLS AND INDICATORS (Continued)

FIGURE 1-8 INDEX NO.	PANEL MARKING	REF DESIG	ASSOCIATED PRINTED CIRCUIT BOARD	FUNCTION
28	SUSTAIN	J2	TR	Provides for connection to Polypedal sustain circuit, controlled by ON/OFF switch.
29	MAIN OUT	J9	TC	Output of all available keyboard signals.
30	BASS OUT	J10	CL	Provides for Bass Filter output.
31	KB OUT	J4	TR	Supplies connection for an external Synthesizer.
32	SINGLE/MULT	SW1	TR	Switch determines single or multiple trigger mode.
	*POWER	S102	PS	ON-OFF AC Power switch.
	*VOLTAGE SELECT	S101	PS	Selects input voltage (95-130 or 190-260 VAC)

* On Rear of Instrument (Not Shown)

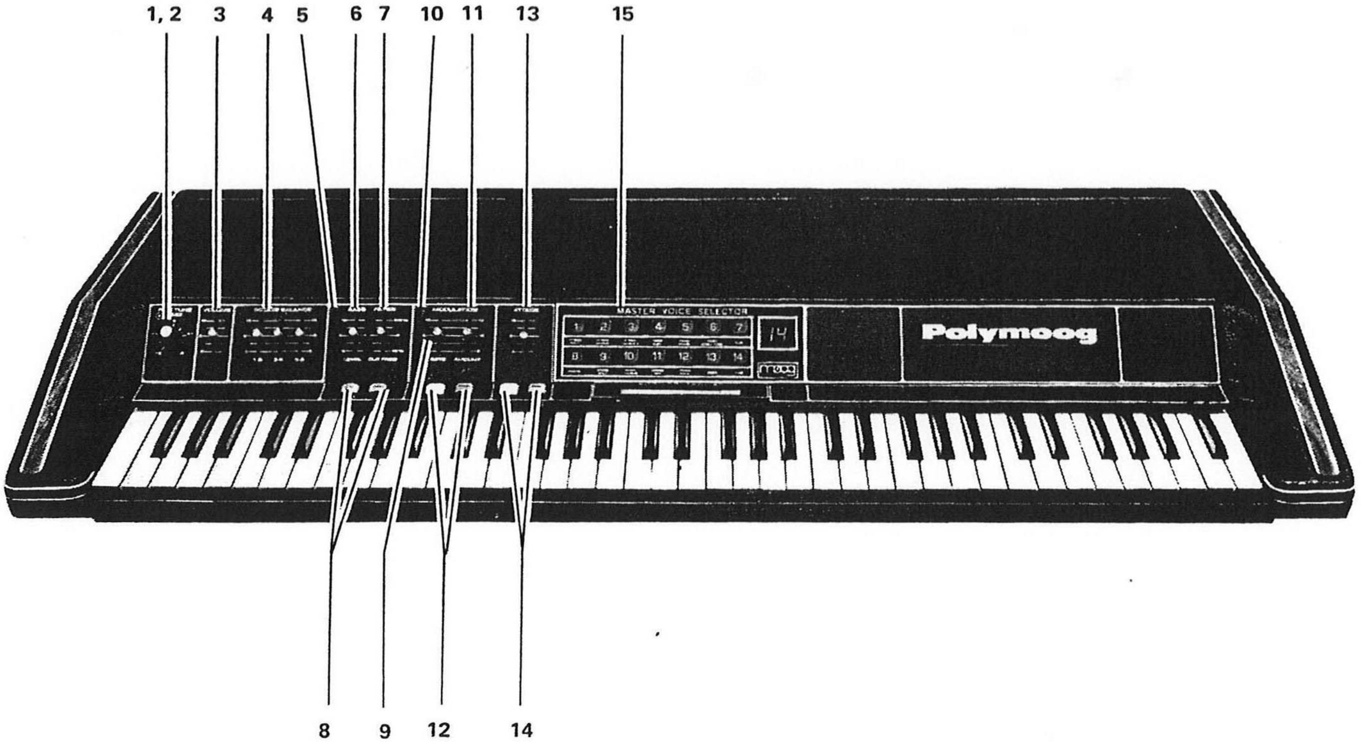

1, 2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
20
19
18
17

FRONT PANEL

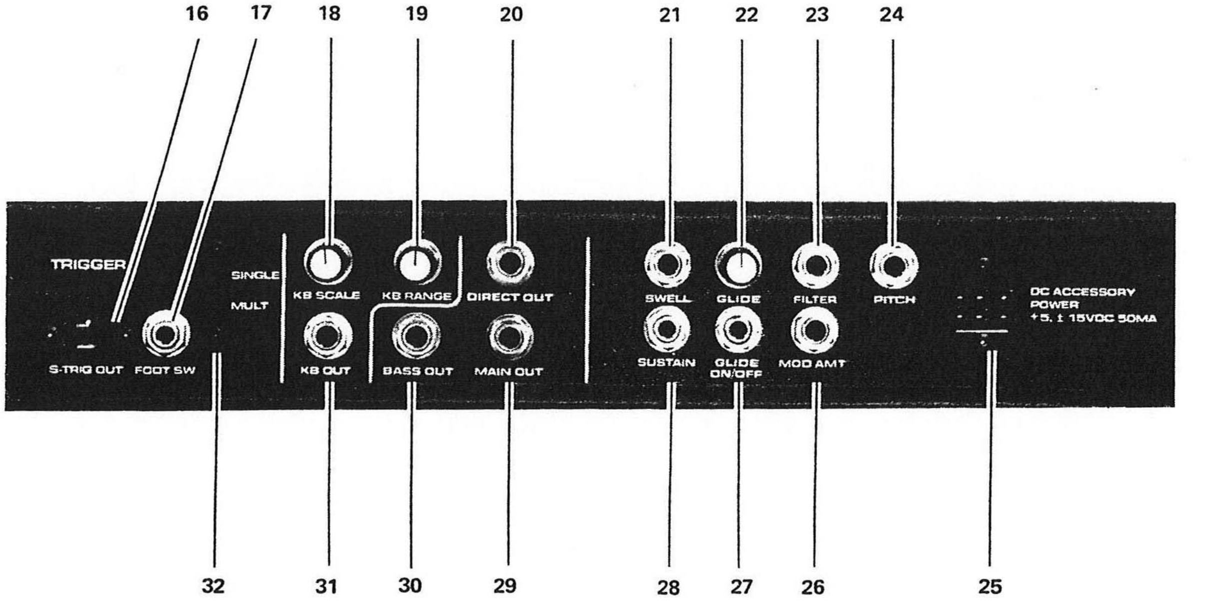

21
22
23
24
25
26
27
28
29
30
31
32
S-TRIG OUT
KB OUT
KB SCALE
MOD AMT
EXT SYN
ON
OFF
TRIG MODE
BAL MIX
MIX
PRE
AUX
VCF
S-TRIG IN
SWELL
FILTER
PITCH
SUSTAIN
ON
OFF
GLIDE
VCF
DIRECT
RES
RES
OUTPUTS
INPUTS
1
2
ACCESSORIES
42
41
40
39
38
37
36
35
34
33

REAR PANEL

FIGURE 1-7 POLYMOOG CONTROLS AND INDICATORS

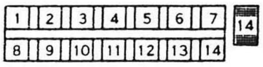

1, 2
3
4
5
6
7
10
11
13
15
MASTER VOICE SELECTOR
Polymoog
8
9
12
14

FRONT PANEL


16
17
18
19
20
21
22
23
24
TRIGGER
SINGLE
MULT
KB SCALE
KB RANGE
DIRECT OUT
SWELL
GLIDE
FILTER
PITCH
DC ACCESSORY
POWER
+5, ± 15VDC 50MA
S-TRIG OUT
FOOT SW
KB OUT
BASS OUT
MAIN OUT
SUSTAIN
GLIDE
ON/OFF
MOD AMT
32
31
30
29
28
27
26
25

REAR PANEL

FIGURE 1-8 POLYMOOG KEYBOARD CONTROLS AND INDICATORS


1
2
3
4
5
6
7
14
8
9
10
11
12
13
14

1.17 KEYBOARD GENERAL SERVICING

Cleaning of the Polymoog keyboard is accomplished using a warm soap and water solution as the use of organic solvents, such as alcohol, may damage the plastic keys. Occasional cleaning of the keyboard contacts may be necessary, especially if the instrument is used extensively in smokey or corrosive conditions. The keyboard contacts may be accessed by unscrewing and removing covers underneath the keyboard at the bottom of the case. Extreme caution must be taken when cleaning the keyboard contacts or damage to one of the delicate spring contacts may result. Use a Q-tip soaked in alcohol or a high quality contact cleaner to remove dirt from the keyboard busses, the long gold plated wires running the full length of the keyboard.

1.18 REMOVAL

The only time it is required to completely remove the Polymoog keyboard is when replacing the entire keyboard or repairing the printed circuit board. To replace a key, set the instrument on a table so that the front edge of the instrument overhangs by approximately eight inches. Remove ten screws under the instrument which fasten the keyboard using a Phillips head screwdriver. Carefully slide the keyboard toward the front of the instrument so that small screws holding the black and white keys to their metal channels are exposed at the rear of the keyboard and remove the screw of the key to be replaced. If a white key is being replaced, gently lift the back part of the plastic and slide the part toward the front. If a black key is being replaced, depress adjacent white keys and remove the black key following the above instructions while holding the white keys depressed.

If it is necessary to remove the entire keyboard, perform the first stage of the front panel disassembly folding back the front panel assembly in a nearly vertical position. Remove 12 six-pin connectors connecting the keyboard to the mother boards and unplug connectors attached to two cables terminating at the right and left of the keyboard. Remove keyboard from unit being careful not to poke fingers underneath the edge of the keyboard when lifting to avoid damaging contacts or dislodging small springs between the keys and keyboard frame which attach to the key lever bars. Refer to Tables 1-6 and 1-7 for keyboard and general mechanical replacement parts lists.

1.19 TROUBLESHOOTING

Troubleshoot the keyboard and harness assemblies using the wire charts, part location diagram and schematic diagram in Volume II.

1.20 POLYMOOG AND POLYMOOG KEYBOARD LEVELING PROCEDURE

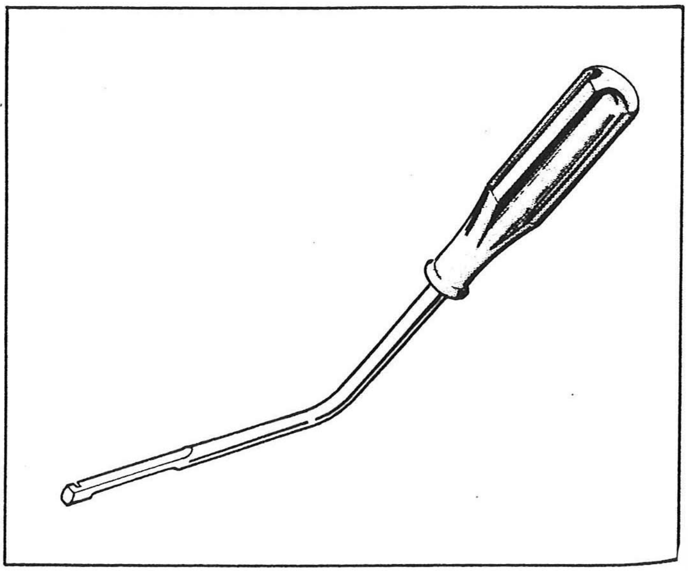
Key height on keyboard also determines contact sequence and wrap. Proper key height adjustment is important for proper keyboard triggering sequence playability. Use of hand leverage or long nose pliers, instead of the tool shown below may permanently damage keyboard mainframes.

a) Slide the keyboard forward after removing the ten screws on the case bottom.

b) Place the tool on the vertical member of the frame underneath the key requiring adjustment.

c) Downward motion moves the key height down.

NOTE
Refer to Volume II, Service Bulletin Section, for additional information.



KEY ADJUSTING TOOL

TABLE 1-6
KEYBOARD ASSEMBLY REPLACEMENT PARTS LIST

PART NUMBER	DESCRIPTION	QTY
997-040383-001	Keyboard Complete, 71 Note	1
949-040254-001	Resistor Pack, 100 Ohm, ± 1%	6
946-041978-224	Capacitor, Polyester, (Mylar), Poly-Carbonate, or Polystyrene 0.22 MFD 10%, 30 Volt	71
852-312333-001	Resistor, 33K Ohm, 1/4 Watt 5%	71
852-312334-001	Resistor, 330K Ohm, 1/4 Watt 5%	71
964-043235-004	Key, Weighted, A Natural	6
964-043236-005	Key, Weighted, B Natural	6
964-043236-006	Key, Weighted, C Natural	6
964-043236-007	Key, Weighted, D Natural	5
964-043236-008	Key, Weighted, E Natural	5
964-043236-009	Key, Weighted, F Natural	6
964-043236-010	Key, Weighted, G Natural	6
964-043236-003	Key, Weighted, Sharp or Flat	29
964-043236-002	Key, Weighted, High D	1
964-043236-001	Key, Weighted, Low E	1
916-043237-001	Bumper, Rubber, Teflon Coated, Key Stop	71
917-043235-001	Key Contact, Gold Plated	71
918-043238-001	Contact, Buss Bar, Gold Plated	2
964-043241-001	Arm, Actuator, Key Contact	71
962-043031-001	Tool, Keyboard Key Height Alignment	1
964-043242-001	Arm, Rocker	71
975-043240-001	Spring, Rocker Arm Return	71
975-043239-001	Spring, Key Return, Black Keys, Light Color	29
975-043239-002	Spring, Key Return, White Keys, Dark Color	2

TABLE 1-7
GENERAL MECHANICAL REPLACEMENT PARTS LIST

PART NUMBER	DESCRIPTION	QTY
968-042149-001	Trim Strip, Aluminum, Top Cover	2
905-042300-003	Pop Rivet, 5/32 x .530, Top Cover Trim Strip	8
913-040328-001	Overlay, "Moog" Logo	1
913-041593-001	Decal, White Dot, Black Key	1
930-042522-001	Phenolic Knob, Knurled Screw, for Truss Bars	2
935-041536-001	Glide, Foot, 3/8-16 Bolt	4
957-041794-001	Power Cord Set, 3 Conductor, 8 Ft.	1
962-040341-001	Knob, Knurled, Front Cover Fastening	2
964-040268-001	Case Top, Vacuum Formed Plastic	1
964-040323-001	Panel, Bezel, Pitch Controller	1
965-040404-001	Truss Bar, Right Side	1
965-040404-002	Truss Bar, Left Side	1
997-040421-003	Leg, Adjustable, Front	2
997-040421-001	Leg, Fixed, Rear	2
68-040403-002	Adapter, Leg, Right Side	1
932-040638-002	Shipping Carton, Complete with Internal Inserts	1
915-040272-001	Knob, Front Panel Slide Control	45
913-040345-001	Insert for Slide Control Knob, Red	8
913-040345-002	Insert for Slide Control Knob, Green	4
913-040345-003	Insert for Slide Control Knob, Yellow	6
913-040345-004	Insert for Slide Control Knob, Black	28
811-060039-016	Screw, Self Tapping, Top Cover Securing, No. 10 x 1 inch	18
973-040789-002	Hinged Post, Printed Circuit Board	6
806-055039-010	Screw, Machine, Keyboard Mounting, 8-32 x 5/8 inch	3
915-040274-001	Knob, Concentric, Front Panel	1
811-050039-012	Screw, Self Tapping, Keyboard Mounting, No. 8 x 3/4 inch	5

1.21 EXTERNAL SYNTHESIZER COUPLING

The external keyboard circuit in the Polymoog provides for coupling (controlling) a monophonic synthesizer such as the Micromoog, Minimoog, or Moog Modular systems from the Polymoog keyboard via rear panel connections (Figure 1-9). Control of other synthesizers is also possible provided keyboard control voltage and trigger compatability are provided.

The Polymoog keyboard circuit has both single and multiple trigger modes which may be controlled by a switch connected to a rear panel TRIG MODE jack. With no switch attached, the instrument is in the "multiple" trigger mode.

The Polymoog has a 71 note keyboard starting on E1. The external keyboard circuitry splits the keyboard in a 24 note (LOWER) section (ending on E♭2) and a 47 note section (UPPER) starting on E3 and ending on D6 (Figure 1-10).

The external keyboard circuit provides a control voltage (which may be scaled using the rear panel KB SCALE control) and a trigger. This control voltage (CV) is either the CV for the highest note of the UPPER keyboard or the lowest note of the LOWER keyboard as selected by the UPPER/LOWER push-button controls on the front panel of the Polymoog. The SPLIT/ALL selector must be in the SPLIT mode in order to activate the LOWER mode. Depressing the ALL mode forces the keyboard splitting function into the UPPER mode, with the keyboard CV derived from the UPPER keyboard but the rear panel trigger output will be derived from the ENTIRE keyboard. Refer to Table 1-8 for various keyboard modes and the associated control voltage and trigger characteristics.

The rear panel EXT SYN jack may be used to turn ON or OFF the control voltage (CV) and the trigger connected to the external keyboard control outputs. The CV and trigger outputs go to an open circuit condition when turned OFF.

1.22 CONTROL VOLTAGE ADJUSTMENTS

Two internal keyboard CV range adjustments set the precise output voltage for the lowest note of the UPPER keyboard signal (R103) and the highest note of the LOWER keyboard signal (R100). These

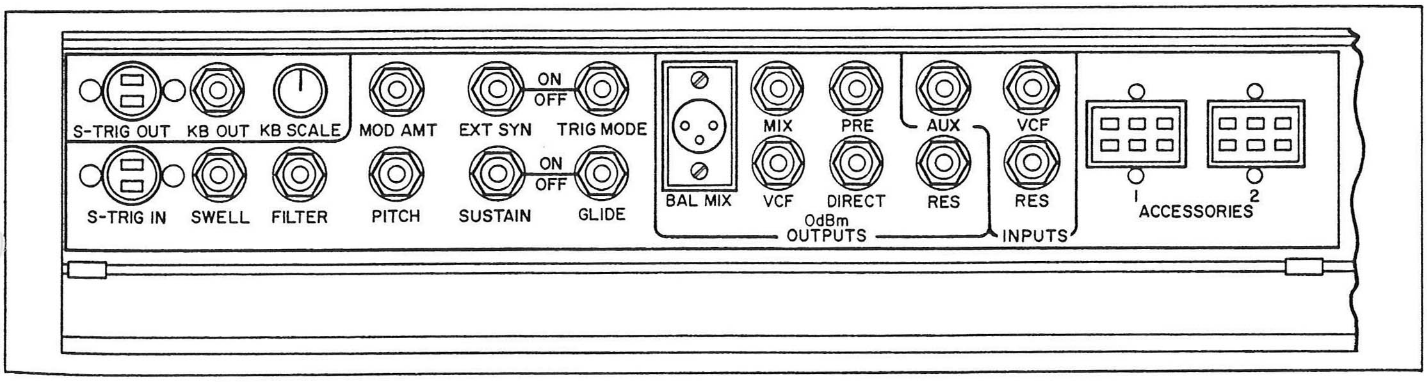


FIGURE 1-9 REAR PANEL

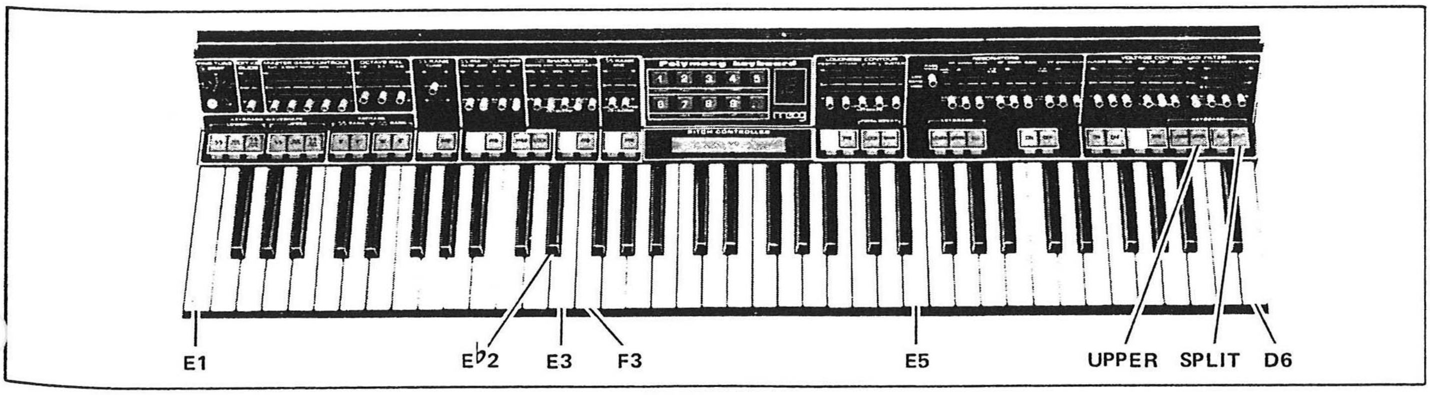


FIGURE 1-10 KEYBOARD

TABLE 1-8. POLYMOOG VARIOUS KEYBOARD MODES

UPPER/LOWER	SPLIT/ALL	CV/PRIORITY	TRIGGER
UPPER	SPLIT	UPPER-high note	From UPPER
LOWER	SPLIT	LOWER-low note	From LOWER
UPPER	ALL	UPPER-high note	From full keyboard

two trim pots are located on the top right (facing the instrument) printed circuit board (Figure 1-10) and may be used to adjust the reference voltage of the note E3 to zero ± 100 millivolts. Since the output CV is nominally 1.00 volt/octave (or 83.3 millivolts/semitone) the output CV may be adjusted so that E3 = 0.00 volts or so that E3 = 0.083 millivolts which establishes F3 = 0.00 volts when the rear panel KB SCALE pot is set for 1.00 volts/octave. In addition, there is an UPPER scale adjustment (R36) hich is used to match precisely the keyboard UPPER and LOWER scale factors.

In general the internal trim RANGE controls are used to adjust for small but important pitch offsets when switching an externally controlled synthesizer ON and OFF using the EXT SYN jack. It is essential in this case that the external synthesizer stay precisely in tune BOTH when played independently and when coupled together. The following procedure describes the alignment procedure to be used when coupling a Micromoog I or II to the Polymoog.

1.23 CONTROL VOLTAGE ALIGNMENT

a. Remove the Polymoog cover and locate trim pots R100 and R103 (Figure 1-11).

b. Put the Polymoog into the SPLIT and UPPER modes using the front panel Polymoog switches. Use Polymoog PRESET 8 and Micromoog 16 pitch setting.

c. Tune the Polymoog and Micromoog to exact unison with the rear panel keyboard CV DISCONNECTED. Use the E3 key of the Polymoog and the lowest E of the Micromoog. Place the Micromoog external keyboard scale pot in the "click position".

d. Connect the Polymoog keyboard CV to the Micromoog keyboard OUTPUT; and while REPEATEDLY DEPRESSING E3 (Figure 1-10) on the Polymoog, adjust the keyboard HIGH RANGE trimpot R103 until both instruments are in tune.

e. Play the E5 note repeatedly (two octaves higher) on the Polymoog and adjust the rear panel KB SCALE pot for exact unison of the Polymoog and Micromoog.

f. Put the Polymoog in the LOWER mode, and while REPEATEDLY PLAYING E♭2 (highest note of the lower keyboard section) adjust the keyboard LOW RANGE trim pot (R100) for exact Polymoog and Micromoog unison.

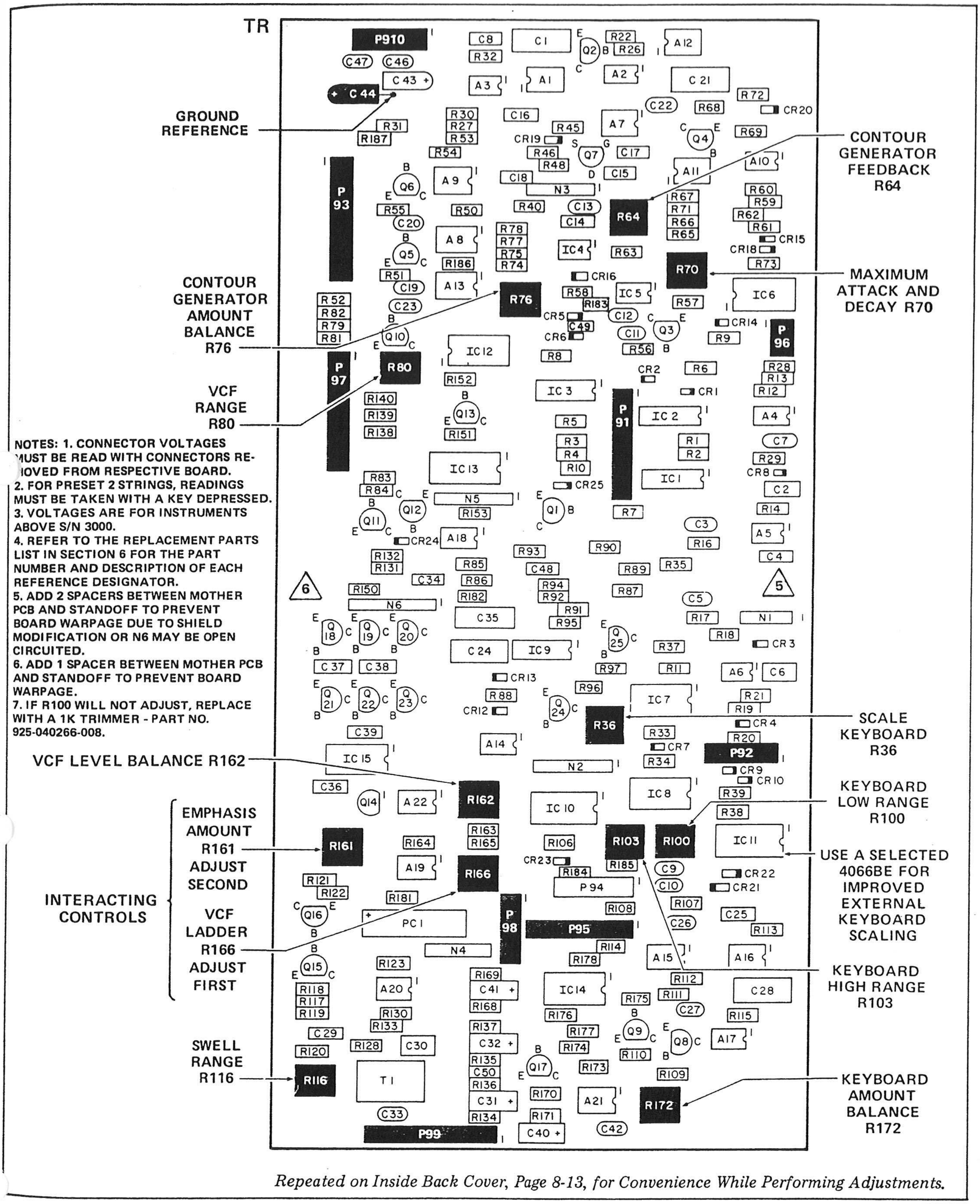
g. Check the LOWER scale by playing lower notes on the LOWER section of the keyboard.

Occasional small adjustment of the rear panel KB SCALE control should be the only adjustment required for setups after the above procedure has been completed. However, if a different Micromoog is substituted, the above procedure MAY have to be repeated.

The Polymoog keyboard output CV may also be connected to the Micromoog OSC input. However, the keyboard voltage of the Micromoog itself will then ADD to the injected CV. In this case the procedure is the same except that steps c thru e must be preceded by depressing the lowest note of the Micromoog to reset the (added) Micromoog CV to zero. This allows the player to use the Micromoog as a "transposing" keyboard, but with the disadvantage that a Micromoog note MUST be played occasionally to eliminate the inevitable long term drift of the keyboard sample and hold (MEMORY) circuit.

The use of the Minimoog is exactly the same as the use of the Micromoog OSC input as previously described.

A modification is available for the Minimoog which eliminates the keyboard control voltage but this modification requires mechanical pull-out of the CV plug at the Minimoog to return it to its own keyboard control.


TR
GROUND REFERENCE
CONTOUR GENERATOR FEEDBACK R64
MAXIMUM ATTACK AND DECAY R70
CONTOUR GENERATOR AMOUNT BALANCE R76
VCF RANGE R80
VCF LEVEL BALANCE R162
SCALE KEYBOARD R36
KEYBOARD LOW RANGE R100
USE A SELECTED 4066BE FOR IMPROVED EXTERNAL KEYBOARD SCALING
INTERACTING CONTROLS
EMPHASIS AMOUNT R161 ADJUST SECOND
VCF LADDER R166 ADJUST FIRST
KEYBOARD HIGH RANGE R103
SWELL RANGE R116
KEYBOARD AMOUNT BALANCE R172
P910
P93
P97
P91
P96
P92
P98
P95
P99
P94
6
5

NOTES: 1. CONNECTOR VOLTAGES MUST BE READ WITH CONNECTORS REMOVED FROM RESPECTIVE BOARD.
2. FOR PRESET 2 STRINGS, READINGS MUST BE TAKEN WITH A KEY DEPRESSED.
3. VOLTAGES ARE FOR INSTRUMENTS ABOVE S/N 3000.
4. REFER TO THE REPLACEMENT PARTS LIST IN SECTION 6 FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.
5. ADD 2 SPACERS BETWEEN MOTHER PCB AND STANDOFF TO PREVENT BOARD WARPAGE DUE TO SHIELD MODIFICATION OR N6 MAY BE OPEN CIRCUITED.
6. ADD 1 SPACER BETWEEN MOTHER PCB AND STANDOFF TO PREVENT BOARD WARPAGE.
7. IF R100 WILL NOT ADJUST, REPLACE WITH A 1K TRIMMER - PART NO. 925-040266-008.

Repeated on Inside Back Cover, Page 8-13, for Convenience While Performing Adjustments.

FIGURE 1-11 VOLTAGE CONTROLLED FILTER AND KEYBOARD PRINTED CIRCUIT BOARD ASSEMBLY (TOP RIGHT BOARD)

1.23.1 POLYMOOG KEYBOARD INTERFACING

The Polymoog Keyboard is interconnected with another instrument, for example, the Minimoog or Micromoog, in a manner similar to that described for the Polymoog Synthesizer. When interconnected, the second instrument will sound the highest key played on the Polymoog Keyboard. Interconnection and tuning is accomplished as follows:

a. Connect the S-TRIG output on the Polymoog Keyboard to the S-TRIG input on the second unit.

b. Connect KB OUT jack on the Polymoog Keyboard to the OSC INPUT on the Minimoog. On the Micromoog or Multimoog, plug into the KEYBOARD OUTPUT jack.

c. Set the second instrument to 8′ and play the lowest F on the Polymoog Keyboard.

d. Adjust the KB RANGE located on the rear panel of the Polymoog Keyboard while repeatedly striking the F key until both instruments are in unison.

e. Adjust the KB SCALE while repeatedly striking the highest note (D) until both units are in unison.

f. Should another unit be interconnected, the tuning process must be repeated due to individual instrument tolerances.

1.24 REAR PANEL CIRCUIT DESCRIPTION AND TROUBLESHOOTING

The controls subassembly provides all input/output connections to the main unit via 36 pin connector S02. The rear panel markings, locations, reference designators, connector pins, line labels and internal connector destinations are shown in Volume II.

The signal ground line (labeled ▽S) is returned to the TR board via pin 1 of P97 while the power or chassis ground is derived from the CR board via pin 2 of P111. These two separate ground lines are used to prevent clicks and pops when the external S-TRIG connections are used or when power is supplied to an external accessory via connector S3 or S4.

When a phone jack is plugged into MIX output connector J10, the output at the BAL MIX connector becomes unbalanced. Note that the VCF and RES inputs at connectors J15 and J16 are shorted to ground when no jack is inserted in order to eliminate clicks due to stray capacitive coupling between S-TRIG signals in the unit and input lines. Signal sources applied to these two inputs via J15 or J16 should have low internal source impedances of less than 10K ohms.

Troubleshoot the rear panel subassembly using the circuit description, (paragraph 8.1 or 8.2), part location and schematic diagrams (Volume II). If any particular input/output control function is completely inoperative, one possible cause is an open connection between the input/output connector and the printed circuit board destination of that function. The schematic may be used to directly track the origin or destination of a rear panel function by noting the connector designation at the bottom of the figure.

Example:

$$\text{P102-5}\left\{\begin{array}{l}\text{Board 10}\\\text{Connector 2}\\\text{Pin 5}\end{array}\right.$$

1.25 FRONT PANEL SUBASSEMBLIES

The front panel subassemblies consist of the right hand control and master preset (CR), mode selector control (MODE) and left hand control (CL) printed circuit board assemblies (Volume II).

1.26 GENERAL SERVICING POLYMOOG AND POLYMOOG KEYBOARD

The front panel control assembly is complex mechanically and electronically. Removal of the control boards involves a number of steps, therefore, it is recommended that careful determination of whether the problem lies in the front panel assembly should be made initially.

The circuit elements most likely to fail are the CMOS packs, LEDs and slide pots and it is possible to replace most of the CMOS packs without removing the control boards. It is necessary to disassemble the front panel section if a slide pot or LED must be replaced.

In general, there is a single CMOS 4007 associated with each front panel slide control function. If a malfunction associated with a particular front panel function occurs and appears to be related to the control signal provided by the front panel assembly, it is recommended that the related CMOS 4007 be replaced. This is usually easier than a detailed circuit analysis of the problem. An error in a particular function of a single preset is probably associated with the programming resistor packs. These resistor packs are plugged into sockets and a programming error could be the result of an improper insertion of the resistor in the connector.

1.27 FRONT PANEL DISASSEMBLY

The procedure for disassembling the front panel assembly will be explained in three parts. The first stage allows access to the bottom of the control boards, the second stage disassembly allows access to the top of the control boards for replacement of parts that are trapped by the front panel extrusion and the third stage is a complete disassembly which is required to replace a slide control or remove the mode selector in the center of this panel.

It should be noted at this point that it is not necessary to disassemble the front panel assembly to replace a RIBBON PITCH CONTROLLER element.

The first stage of this disassembly proceeds as follows:

a. Remove two screws on the far left and two screws on the far right which pass through the black support bars attached to the front panel extrusion and screw into the side support brackets.

b. Remove sheet metal screws across the back of the control boards which screw directly into the instrument base.

NOTE

The entire front panel assembly may now be lifted up and folded back 180° above the keyboard in order to gain access to the bottom of the control boards.

The second stage of this disassembly is accomplished by rolling back the front panel assembly and removing the screws which hold the control boards to the front panel extrusion near the front and removing three screws which tie the control boards to the support brackets between the control boards and the front panel extrusion. The unit may be turned on and operated at this point. However, caution should be exercised to prevent shorts between the bottom of the control boards and the keyboard. This is accomplished by laying a strip of insulating material, i.e., cardboard, across the top of the keyboard to prevent shorting. This stage allows for LED replacement.

The third stage of disassembly is necessary only if it is required to replace a front panel slide pot or to remove the mode selector control board. This is accomplished by removing six screws which connect the top rear of the front panel extrusion to six brackets between the extrusion and the control boards. Once these screws have been removed, the front panel proper may be disconnected from the control boards by pulling the white connectors which plug into the control boards. Remove the slide pot subassembly as follows:

a. Remove all slide pot knobs using a small screwdriver to carefully pry off the knob pushing against the extrusion with the screwdriver.

b. Invert complete assembly and remove screws holding plastic tiewraps to the hex standoffs.

c. Remove the hex standoffs and nuts holding the slide pot assembly up against the front panel extrusion.

d. Remove slide pot by unsoldering wires and removing two small screws holding slide pot to subassembly plate.

1.28 RIBBON PITCH CONTROLLER REMOVAL

a. Remove the two outer screws which hold down the pitch controller base plate.

b. Lift entire pitch controller assembly up and out a short distance, enough to view the three wires attached and remove two inner screws holding the pitch controller element to the base plate.

c. Unsolder three wires from the pitch controller element noting carefully which wire is attached to its respective location.

1.29 TROUBLESHOOTING

Troubleshoot the front panel assemblies in accordance with instructions for Polymoog and Polymoog Keyboard contained in Section 7. Note that voltage levels and waveforms displayed on the schematic diagrams are not absolute values as readings may vary between units. Once the problem is localized, check the suspected part by direct substitution if possible. Otherwise use a voltmeter or oscilloscope to determine the malfunctioning part.

It is possible that the failure of one of the CD4007 integrated circuits used as an analog switch may fail in a manner that shorts the control line to all CD4007s in a section to either the negative or positive voltage rails. In this case, it will appear that all control functions in a particular section controlled by one VAR-PRE switch are defective simultaneously. For example, the VCF VAR-PRE switch control line for the right hand control panel (board 11) is labeled ZZ. If the ZZ line does not switch between +15 VDC and ground when the VAR-PRE switches are depressed, it could be the result of either a failure in control IC2 or any one of integrated circuits IC3 thru IC10.

Drive line generator IC2 should be replaced first. If the ZZ line still does not switch properly, then IC3, IC4, IC5, etc. should be sequentially removed while monitoring the ZZ line with an oscilloscope and switching back and forth between the VAR-PRE modes. Leave out the removed integrated circuits until the ZZ line operates properly. The defective pack is the one which prevents the ZZ line from switching.

Replacement of TIP29 and TIP30 power transistors for the 4.85V and -5.5V supplies requires drilling out the rivets with a No. 22 drill. For later instruments, removable screws and Tinnerman fasteners are used to mount the transistors. These parts may be used in older instruments for convenience once the old parts are removed.

TABLE 1-9

POLYMOOG FRONT PANEL SUBASSEMBLY REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	997-040382-001	Front Panel Subassembly consisting of:	
	997-040384-001	Resistor, Slide Subassembly, Left Side, consisting of:	
R5,R7,R11, R13,R17,R19, R47,R58,R68, R80	925-040826-001	Resistor, Slide, Audio, 10K Ohm.	10
R9,R15,R21, R42,R49,R51, R53,R55,R59, R69,R81	992 925-041~~192~~-001	Resistor, Slide, Linear, 10K Ohm	11
R105,R107	925-041993-001	Resistor, Rotary, Dual, 100K Ohm, Linear Concentric Shaft . .	2
	997-040385-001	Resistor, Slide Subassembly, Right Side, consisting of:	
R1,R2,R3, [illegible],R29,R41, [illegible],R49,R53, R57,R63,R179, R180	925-040826-001	Resistor, Slide, Audio, 10K Ohm	13
R20,R34,R45, R46,R51,R65, R66,R67	992 925-041~~192~~-001	Resistor, Slide, Linear, 10K Ohm	8
R60,R70,R82	925-040827-001	Resistor, Dual Slide, Linear, 10K Ohm.	3
	997-040387-001	Panel and Ribbon Control Assembly	1
R62	997-041596-001	Ribbon Control Assembly	1
L1	939-041850-001	Diode, Light Emitting	1
SW1	960-040230-001	Switch, Slide, 6 Position	1
	915-040274-001	Knob, Dual.	1
	915-040272-001	Knob, 1/4 Diameter	45
	915-040297-001	Knob, 1/4 Diameter	1
	913-040345-004	Knob Insert, No. 189, Black	28
	913-040345-001	Knob Insert, No. 117, Red	8
	913-040345-002	Knob Insert, No. 122, Green	4
	913-040345-003	Knob Insert, No. 120, Yellow.	6

TABLE 1-10
POLYMOOG KEYBOARD FRONT PANEL SUBASSEMBLY
REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
		Front Panel Subassembly consisting of:	
C6	947-040200-103	Capacitor, Disc, 0.01uf	1
C7	947-040200-102	Capacitor, Disc, 0.001uf	1
C16	946-040231-003	Capacitor, 2.7uf, 35V	1
J1,J4,J6,J7, J8,J9,J11	910-041306-001	Jack, Phone, Single Circuit	7
J2,J3,J5	910-041632-001	Jack, Phone, 0.206 Dia., Shorting	3
J10	910-041306-004	Jack, Phone, Stereo, (2 circuit)	1
L1	939-041850-001	LED, Red	1
P1	910-041697-002	Plug, Panel, 2 Conductor	1
R19,R20,R21, R106,R108	925-041992-001	Resistor, Slide, 10K Ohm, Linear	5
R23	852-312103-001	Resistor, 10K Ohm, ±5%, 1/4W	1
R54,R109	925-040827-001	Resistor, Dual Slide, 10K Ohm, Linear	2
R55,R56	925-040826-001	Resistor, Slide, 10K Ohm, Audio	2
R105,R107	925-041993-001	Resistor, Rotary, 100K Ohm, Linear, Concentric Shaft, Tandem	2
R106	852-312105-001	Resistor, 1 Megohm, ±5%, 1/4W	1
R110	925-042731-001	Resistor, Rotary, 2K Ohm, Linear, Cermet	1
R111	925-042732-002	Resistor, Rotary, 100K Ohm, Linear	1
R112	925-042732-001	Resistor, Rotary, 2.5 Megohm, Audio	1
SW1	960-042638-001	Switch, Slide, Single Pole, Double Throw, Black	1
S1	910-041707-006	Socket, Panel, 6 Conductor	1
S10	906-040392-010	Housing, 10 Position Without Ramp	1
S11,S21,S103	906-040298-005	Housing, Socket, 5 Pin, CIS, (0.100 Centers)	3
S41,S43 thru S46,S51,S53 thru S56,S61, S63 thru S66, S82,S107 thru S109,S1011 thru S1015	906-040304-006	Housing, Socket, 6 Pin, CIS, Keyed, (0.150 Centers)	24
S42,S52,S62, S710	906-040305-007	Housing, Socket, 7 Pin, CIS, Keyed, (0.150 Centers)	4
S71,S75,S96, S97	906-040300-007	Housing, Socket, 7 Pin, CIS, (0.150 Centers)	4
S72,S83,S92, S93,S95	906-040300-006	Housing, Socket, 6 Pin, CIS, (0.150 Centers)	5
S73	906-040300-009	Housing, Socket, 9 Pin, CIS, (0.150 Centers)	1
S74,S325	906-040300-004	Housing, Socket, 4 Pin, CIS, (0.150 Centers)	2
S76,S77,S84, S98	906-040300-008	Housing, Socket, 8 Pin, CIS, (0.150 Centers)	4
S78,S79	906-040300-003	Housing, Socket, 3 Pin, CIS, (0.150 Centers)	2
S81,S94,S910	906-040300-010	Housing, Socket, 10 Pin, CIS, (0.150 Centers)	3

TABLE 1-10
POLYMOOG KEYBOARD FRONT PANEL SUBASSEMBLY
REPLACEMENT PARTS LIST (Continued)

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
S91	906-040302-005	Housing, Socket, 5 Pin, CIS, Keyed, (0.150 Centers)	1
S101	906-040298-007	Housing, Socket, 7 Pin, CIS, (0.100 centers)	1
S102	906-040298-009	Housing, Socket, 9 Pin, CIS, (0.100 Centers)	1
S104, S301 thru S324	906-040298-006	Housing, Socket, 6 Pin, CIS, (0.100 Centers)	25
S105,S106	906-040298-003	Housing, Socket, 3 Pin, CIS, (0.100 Centers)	2
	906-040392-001	Housing, 15 Position, Without Ramp	1
	906-040298-002	Housing, Socket, 2 Pin, (0.100 Centers)	1
	910-040312-002	Receptacle, 0.058	144
	910-040308-001	Socket, Contact, CIS.	516
	910-040393-002	Socket, 0.045 Series	22
	910-040310-001	Plug, CIS, Keying	2
	914-042530-001	Seal, Slide Potentiometer	1
	913-040345-007	Knob.Insert, No. 109, Blue.	9
	913-042534-001	Overlay, Front Left	1
	913-042535-003	Overlay, Front Right.	1
	913-042536-001	Overlay, Switches.	1
	913-042537-001	Overlay, Right (Blank)	1
	913-042538-001	Overlay, Controls	1
	915-040273-001	Knob, 1/4 in. Bore	3
	915-040274-001	Knob, Dual, 0.265 in., ID/0.187 in., ID.	1
	915-040272-001	Knob, 1/4 in. Dia.	9
	959-042540-001	Diffuser	1
	963-040633-002	Limit Stop, Slide Potentiometer	1
	963-042529-001	Plate, Support, Slide Potentiometer	1

1.[illegible] POLYPEDAL

The Polymoog pedal accessory (Polypedal, Figure 1-12) provides six control functions to the Polymoog. Three of these control signals, namely the PITCH, FILTER and SWELL functions are continuous control signals ranging from zero to 5VDC. The other three functions, namely, the EXT, SYN, TRIG MODE and SUSTAIN are switch controls.

There are four functions on the Polymoog which may be controlled by the three continuous control signals: PITCH, MOD. AMT. and SWELL. It should be noted that the PITCH control signal from the Polypedal can be used only to source con-[illegible] current, and that the MOD. AMT. input on the Polymoog requires sinking current. Thus, the PITCH output of the Polypedal cannot be used to drive the MOD. AMT. input on the Polymoog.

The Polypedal assembly receives +5VDC power via the six pin Jones connector P7. There are two ground lines in the Polypedal circuit. The first of these, the power ground, is connected to P7, pin 2. This power ground carries the LED indicator lamp currents and is separated from the signal ground so that the on and off switching of the LEDs will not cause voltage offsets at the Polypedal because of the finite ground wire resistance. The power ground is shown as an inverted triangle with the symbol "P" inside and the corresponding signal ground is shown as an inverted triangle with an "S" inside. The signal ground is connected to the Polymoog or Polymoog Keyboard via the SWELL OUTPUT phone jack body. The pitch/filter potentiometer R1 is connected between ground and the +5VDC rail. The center tap on R1 (controlled by the left most "gas" pedal) is connected to the FILTER OUTPUT via the FILTER switch SW2 and to the PITCH output via the diode

CR1 and the secondary dividing potentiometer R2, a pitch range control potentiometer mounted on the rear of the Polypedal assembly. The diode CR1 provides deadbanding of the pitch control output voltage so that when the control pedal is in the retarded position, the output of the PITCH control line is precisely 0.000 VDC. The pitch scale potentiometer R2 allows the player to set the maximum effect of the pitch filter drive pot R1 to the desired musical interval. The PITCH and FILTER switches SW1 and SW2 respectively, simultaneously connect the respective outputs to the drive point and also turn on the indicating LEDs L1 and L2 at the same time. The capacitor C1 eliminates potentiometer noise on the PITCH/FILTER output lines.

The SWELL control signal is derived directly from the wiper of the SWELL potentiometer driven by the right most "gas" pedal. Potentiometer bypassing for this control signal occurs in the Polymoog itself.

The TRIG MODE and SUSTAIN controls are momentary foot switches which short the respective control lines to ground. The TRIG MODE switch has a reversing switch SW4 on the rear of the Polypedal which reverses the action of the foot pedal.

1.31 POLYPEDAL DISASSEMBLY PROCEDURE

(Refer to Volume II for Illustrated Parts List)

The Polypedal can be serviced without complete disassembly for the majority of troubleshooting and adjustment procedures. Disassembly is performed as follows:

1.31.1 REAR COVER REMOVAL

Remove the four screws securing the rear cover. The following operation can be performed without further disassembly:

a. Cleaning switch contacts at the switch pedals.

b. Troubleshooting can be performed on the push switches, internal wiring and the components on the terminal strips. LED replacement can also be accomplished.

1.31.2 CONTROL PEDALS ADJUSTMENT

a. Pinion gear adjustment by use of a right angle drive Phillips screw driver.

b. Friction washer adjustment using right angle drive flat screw driver.

NOTE

The pedal has separate power and signal grounds. When troubleshooting the pedal separately from the Polymoog, the signal ground connected to the sleeve of the swell plug is independent of power ground (P7, pin 2). Place a jumper from signal to power ground when measuring output of control pedals.

1.31.3 CONTROL PEDALS REMOVAL

a. Remove the four screws and cup washers from the control pedal and lift out the pedal assembly.

CAUTION

Use care to avoid stress on solder connectors to the rotary pot.

b. Turn pedal end to end to gain access to pinion adjustment screw on friction washer adjustment bolt.

c. Adjust rack and pinion by loosening the 8-32 screw on the pot side of the bracket. The spool and spacer assembly will slide back in slot to disengage pinion.

1.31.4 SWITCH PEDALS REMOVAL

a. SUSTAIN and TRIG MODE switches are subassembled to a wood spacer. Remove the four screws and slide both switch assemblies out the rear opening in the vacuum formed enclosure. Remove pedals from spacer by loosening the two screws.

b. Leaf switches can be removed without further disassembly by removing the two screws.

c. The selflocking nut, which retains the pedal up-stop washer, can be adjusted slightly loose to orrect rubbing of spacer against rubber grommet.

1.31.5 ACCESS TO THE VACUUM FORMED ENCLOSURE

a. Remove four screws.

b. Remove pedal subassemblies and slide enclosure to rear to clear front aluminum extrusion.

c. Push switches and LEDs are each subassembled to the metal bracket. Remove knurled nut and washer from each switch and the two screws from each metal bracket.

d. Remove the hexagon nut and lock washer securing the switch to the panel and remove switch.

> **NOTE**
> Hexagon nut and washer are used to provide clearance for the LED.

e. Rear panel components are subassembled t the rear panel. To remove the panel, remove the control knobs and screws and remove subassembly.

> **NOTE**
> Pitch trim pot is mounted to the rear panel using a special nylon friction locking nut. When installing, rotate nut on pot shaft to ease assembly.

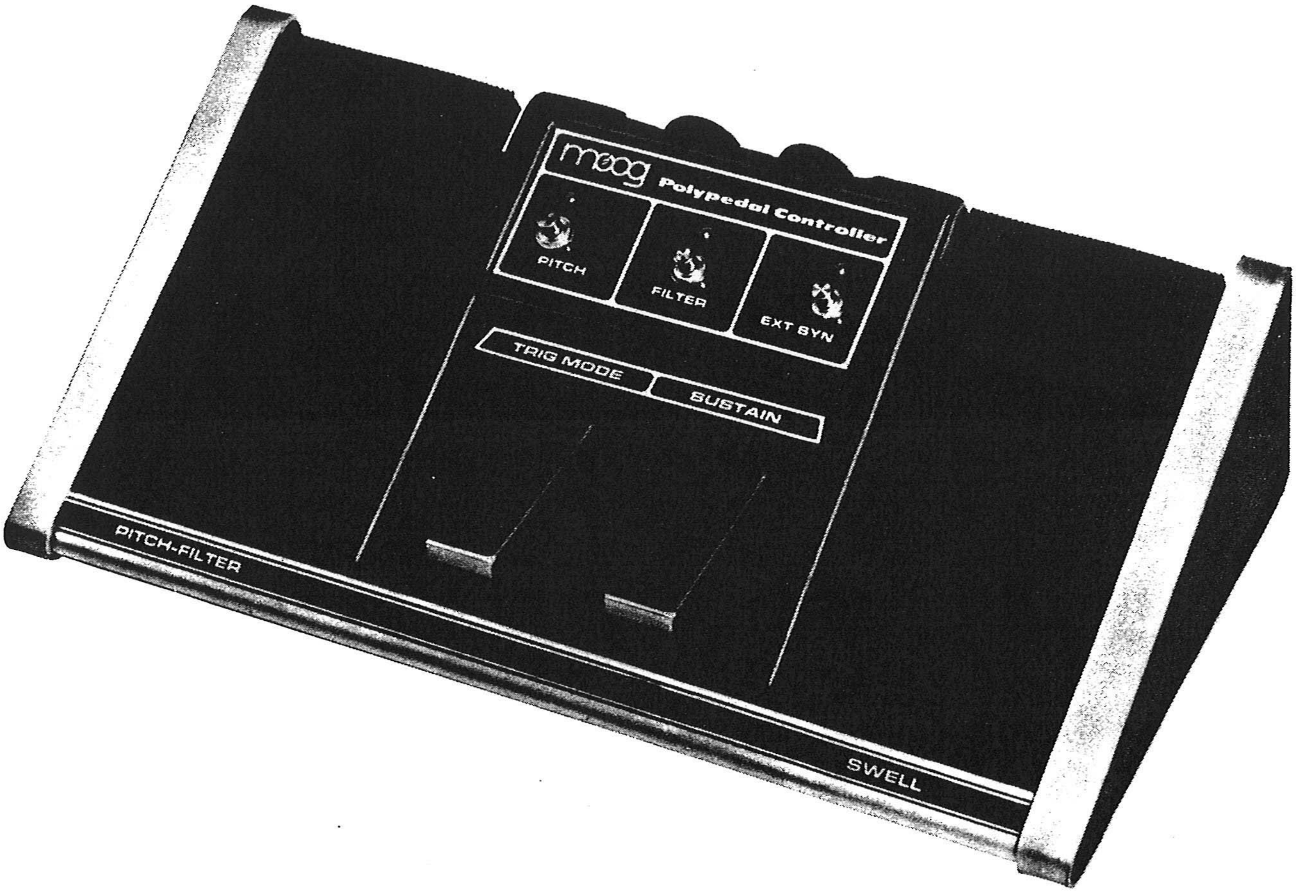


FIGURE 1-12 POLYPEDAL

SECTION 2
BOARDS 1, 2, 3
DIVIDER AND HIGH FREQUENCY OSCILLATORS

2.1 CIRCUIT DESCRIPTION

The divider and high frequency oscillator are used in both the Polymoog and Polymoog Keyboard. The circuit description that follows was developed primarily for the Polymoog and applies in general to the Polymoog Keyboard.

The divider printed circuit board assembly (board 3) carries 24 six stage PMOS frequency dividers and two 20-pin connectors for high frequency oscillator printed circuit boards 1 and 2. (Refer to Volume II).

Each high frequency oscillator board provides a full set of 71 audio tone sources to the modulator boards on each mother board. The rank 1 divider set provides drive for the sawtooth waveforms. The lines from the divider board to the modulator boards are labeled G_n where n is the note number, 1 being the lowest note on the keyboard. Power enters the board on 4-pin connector P325 and the +5.0 VDC supply is routed directly to the high frequency oscillator boards. The divider chips are powered by +15 VDC, ground and -15 VDC. The high frequency oscillator board provides the top twelve notes of the scale directly to the connectors and a 13th note one octave below the highest note of the original 12.

Each high frequency oscillator board is comprised of five sections: (1) a high frequency oscillator; (2) two-stage frequency divider; (3) octave selection gates plus a driver; (4) top octave synthesizer integrated circuit; and (5) selection gates for the return frequency to the phase comparators on the top left board.

The high frequency oscillator is comprised of Q1, IC1 (G1 and G2), IC4 (G3) and associated components. The output from the phase comparator on the top left board enters at pin 5 of P11/21 and is applied to a shelving filter comprised of R1, C1, R2 and C2. The phase comparator output is a switched signal filtered by this shelving filter and buffered by Darlington transistor Q1 which provides current to integrating capacitor C3 of the VCO via R3. Gates G1 and G2 are Schmitt triggers with upper and lower thresholds of approximately 0.8 and 1.7 VDC. When voltage across C3 reaches the upper trigger threshold of G1, the output of G1 goes negative causing the output of G2 to go positive causing the open collector output of G3 to shunt the voltage across C3 to ground. This action causes the polarity of gates G1, G2 and G3 to reverse and the voltage again begins to rise across capacitor C3. The oscillator output on pin 6 of IC1 is a 100 nsec pulse driving frequency divider G4 which drives a second frequency divider, G5. The first frequency divider, G4, is used merely to provide a square wave output while the second frequency divider provides an octave selection signal. The nominal range of the VCO comprised of Q1, IC1 and G3 of IC4 is 2 to 4 MHz.

Octave selection is achieved by selecting either the divided by 2 or divided by 4 high frequency signals using gates G6 and G7 (IC4) which are open collector output AND gates. Either G6 or G7 is enabled by a logic 1 on pin 1 or 3 of P11/21. The selected 15 volt square wave on pins 3 and 6 of IC4 is buffered by the complementary emitter follower driver comprised of Q2 and Q3. Resistor R8 is a protection resistor in case either Q2 or Q3 should fail. The 15 volt drive signal is applied to pin 2 of the top octave synthesizer (TOS), IC5. This IC generates the top 12 notes of the scale and in addition, a 13th output one octave below the highest of the twelve. These 13 tone source frequencies are applied to the divider board via edge connectors S1 and S2. These tone source frequencies are divided down on the divider board and applied to the modulator boards. In addition, a pair of outputs separated in frequency by one octave from the divider board are returned via pins 11 and 12 to the high frequency oscillator board when the drive frequency to the TOS is changed by an octave via control on pins 1 and 3 and gates G6 and G7 (IC4). Simultaneously, selection of one of two divided down and octavely related signals is returned to the high frequency oscillator board via G8 and IC3.

When the octave selection lines on pins 1 and 3 of P11/21 select the high frequency from divider G4 via G7, the lower frequency is selected to be returned to the phase comparators on the TL board via G* and IC3. Thus, when a rank is switched an octave higher the dividers are driven at twice their original frequency, but a return signal of half the frequency is sent back to the phase lock loop. The result is that the return frequency to the phase lock loop stays the same. Indeed the phase lock loop on the TL board is unaware that an octave shift has taken place except for a phase glitch.

2.2 GENERAL SERVICING

Malfunction of the divider packs on the divider board is easily determined by noting the absence of a 15 volt audio waveform on the G connectors at the edge of each mother board. If no waveform is present at the edge of the mother board, record which note number in sequence of the keyboard is defective (note 1 is the lowest note) and determine whether it is a sawtooth rank or rectangular rank pulse. If it is a sawtooth rank, the inoperative pack can be located by noting which divider pack carries the appropriate key number designation. A similar procedure holds for the rectangular rank where the defective pack can be located by noting which pack carries the designator N_n being the note number mentioned previously.

The overall tone source system is comprised of three parts: (1) the reference oscillators on the TL board; (2) the high frequency oscillator which contains the top octave synthesizer; and (3) the frequency divider section. Malfunction of any one of these three sections can cause tone source problems since all three sections are in a feedback loop controlled by the phase lock circuitry on the TL board. Exchanging the high frequency oscillator boards will usually determine whether the difficulty lies with the high frequency oscillator board or the associated divider board section. If several notes in an octavely related note series for one of the oscillator ranks is completely dead, the TOS (IC5) or the first divider pack connected to the TOS is most likely at fault.

If there is hash or jitter in one of the oscillator rank systems, determination of whether this fault is caused by the phase-lock loop or the high frequency oscillator may be made by jumping the base of Q1 to Vcc (+5 VDC). The phase lock loop circuitry is now defeated and the high frequency oscillator will run at a constant frequency, eliminating all jitter. Examination of the high frequency oscillator output at pin 1 of IC2, the driver output applied to pin 2 of the TOS (IC5) and the outputs of the TOS will determine whether the difficulty is in the high frequency oscillator, divider, driver or TOS.

NOTE

The power supply output voltages must be checked and adjusted if necessary (refer to Table 8-1) prior to all troubleshooting procedures and after replacement of all malfunctioning parts.

2.3 REMOVAL

a. Remove 24 six-pin connectors from the divider board, two 5-pin connectors from the high frequency oscillator boards and carefully pull the high frequency oscillator boards from their edge connectors on the divider board.

b. Remove the six Phillips head screws from the divider board and lift divider board from unit.

CAUTION

When reinstalling divider board, use extreme caution when attaching the power supply connector to insure that it is properly polarized (note polarizing pin on connector).

2.4 TROUBLESHOOTING

Troubleshoot the divider and high frequency oscillator boards using Table 2-1, the circuit description (paragraph 2.1), part location and schematic diagrams (Volume II). Note that voltage levels and waveforms displayed on the schematic diagram are not absolute values as readings may vary between units. Once the problem is localized, check the suspected part by direct substitution if possible. Otherwise use a voltmeter or oscilloscope to determine the malfunctioning part.

TABLE 2-1

POLYMOOG AND POLYMOOG KEYBOARD DIVIDER AND HIGH FREQUENCY OSCILLATOR BOARD TROUBLESHOOTING

PROBLEM	PROBABLE DEFECTIVE COMPONENT
High frequency oscillator dead	Q1, IC1, IC4
High frequency oscillator runs, no drive to pin 2 of IC5	IC2, IC4, Q2, Q3
Drive signal to pin 2 of TOS (IC5), no TOS output	IC5
Octave switching malfunction	IC3, IC4, IC2
One tone frequency dead	Related divider pack on divider board
High frequency oscillator stays at maximum frequency	IC3

TABLE 2-2

DIVIDER PRINTED CIRCUIT BOARD ASSEMBLY REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-040135-001	Divider Printed Circuit Board Assembly, consisting of:	
	996-040153-001	High Frequency Oscillator Printed Circuit Board Assembly (S1 and S2)	2 Ref
C1 thru C3	947-040200-103	Capacitor, Disc, 0.01uf	3
CR1 thru CR3	919-042019-001	Diode, Rectifier, 1N4004	3
IC1 thru IC24	991-042015-001	Integrated Circuit, MM5823N.	24
P31 thru P39, P310 thru P324	910-040299-006	Header, Printed Circuit, 6 Pin, (0.1 Centers) AMP640098-6	24
P325	910-040303-004	Header, Printed Circuit, 4 Pin, Keyed (0.15 Centers), AMP640242-4.	1
S1,S2	910-041746-020	Connector, 20 Pin, AMP530403-1	2

TABLE 2-3

HIGH FREQUENCY OSCILLATOR PRINTED CIRCUIT BOARD ASSEMBLY REPLACEMENT PARTS LIST (Version 1)

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-040153-001	High Frequency Oscillator Printed Circuit Board Assembly, consisting of:	
C1	946-040229-474	Capacitor, Polyester, 0.47uf	1
C2	946-040229-224	Capacitor, Polyester, 0.22uf	1
C3	947-040020-501	Capacitor, Disc, 500pf, ± 20%, 20V	1
C4,C5	946-040231-001	Capacitor, Ta., 1.5uf, ± 20%, 20V	2
CR1	919-041075-004	Diode, 1N4148, Alt. 1N914	1
IC1	991-041095-001	Integrated Circuit, SN7413N	1
IC2	991-041098-001	Integrated Circuit, 7473N	1

TABLE 2-3

HIGH FREQUENCY OSCILLATOR PRINTED CIRCUIT BOARD ASSEMBLY REPLACEMENT PARTS LIST (Version 1) (Continued)

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
IC3	991-041088-001	Integrated Circuit, CM4011AE	1
IC4	991-041096-001	Integrated Circuit, SN7426N	1
IC5	991-041105-001	Integrated Circuit, Top Octave Syn	1
P11/21	910-040299-005	Header, Printed Circuit, 5 Pin, Keyed (0.1 Centers), AMP640098-5	1
Q1	991-041053-001	Transistor, NPN, Darlington, D16P1	1
Q2	991-041051-001	Transistor, NPN, 2N3904	1
Q3	991-041052-001	Transistor, PNP, 2N3906	1
R1,R5,R6	852-312104-001	Resistor, 100K Ohm, ± 5%, 1/4W	3
R2,R9	852-312103-001	Resistor, 10K Ohm, ± 5%, 1/4W	2
R3	852-312152-001	Resistor, 1.5K Ohm, ± 5%, 1/4W	1
R4	852-312223-001	Resistor, 22K Ohm, ± 5%, 1/4W	1
R7	852-312102-001	Resistor, 1K Ohm, ± 5%, 1/4W	1
R8	852-312470-001	Resistor, 47 Ohm, ± 5%, 1/4W	1
R9	852-312105-001	Resistor, 1 Megohm, ± 5%, 1/4W	1
	906-040307-007	Socket, Integrated Circuit, SIL, 7 Pin, AMP1-583773-4	2
	906-040307-008	Socket, Integrated Circuit, SIL, 8 Pin, AMP1-583773-5	2

TABLE 2-4

HIGH FREQUENCY OSCILLATOR PRINTED CIRCUIT BOARD ASSEMBLY REPLACEMENT PARTS LIST (Version 2)

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-042870-001	High Frequency Oscillator Printed Circuit Board Assembly, consisting of:	
C1	946-040229-474	Capacitor, Polyester, 0.47uf	1
C2	946-040229-224	Capacitor, Polyester, 0.22uf	1
C3	947-042020-501	Capacitor, Disc, 500pf	1
C4,C5	946-040231-001	Capacitor, Tantalum, 1.5uf, 20V	2
CR1	919-041075-001	Diode, 1N4148, Alt. 1N914	1
IC1	991-041095-001	Integrated Circuit, DM7413N	1
IC2	991-041098-001	Integrated Circuit, 7473N	1
IC3	991-042883-001	Integrated Circuit, 4052B	1
IC4	991-041096-001	Integrated Circuit, SN7426N	1
IC5	991-041105-001	Integrated Circuit, Top Octave Syn	1
P11/21	910-040299-005	Header, Printed Circuit, 5 Pin, Keyed (0.1 Centers), AMP640098-5	1
Q1	991-041053-001	Transistor, NPN, Darlington, D16P1	1
Q2	991-041051-001	Transistor, NPN, 2N3904	1
Q3	991-041052-001	Transistor, PNP, 2N3906	1
R1	852-312104-001	Resistor, 100K Ohm, ± 5%, 1/4W	1
R2,R4	852-312103-001	Resistor, 10K Ohm, ± 5%, 1/4W	2
R3	923-042279-001	Resistor, 1.8K to 3.3K Ohm, Selected, ± 5%, 1/4W	1
R5,R6	852-312223-001	Resistor, 22K Ohm, ± 5%, 1/4W	2
R7	852-312102-001	Resistor, 1K Ohm, ± 5%, 1/4W	1
R8	852-312470-001	Resistor, 47 Ohm, ± 5%, 1/4W	1
R9	852-312105-001	Resistor, 1 Megohm, ± 5%, 1/4W	1
	906-040307-008	Socket, Integrated Circuit, SIL, 8 Pin, AMP1-583773-5	4

SECTION 3
BOARDS 4, 5, 6
MOTHER BOARDS, MODULATOR AND BALANCE BOARDS

3.1 CIRCUIT DESCRIPTION

Circuitry for the low, medium and high mother boards is identical except for capacitor values. Each mother board contains 25 20-pin connectors, 24 of these connectors are for identical modulator boards while the center connector is for the balance board. (Refer to Volume II for schematics).

The 20-pin connectors are labeled S1 thru S25, respectively and the following pin references refer to these connectors. Tone frequencies are injected at the rear of the mother board on single pin connectors. Two frequencies per modulator board are applied to pins 17, 18 and 20 via capacitors. The two tone sources are 15 volt peak-to-peak square waves derived from the divider board. The keyboard drive signal is applied to pin 1 and power supply voltages of -5.5 and +4.85 VDC are applied to pins 9 and 8, respectively. Drive level limit control is applied to pin 11, final decay (with sustain) to pin 12, pulse width control to pin 13, sawtooth level control to pin 15, decay control to pin 16 and brightness control to pin 10. Pin 14 is the balance control to pin 10. Pin 14 is the balance control line driven by the balance board plugged into connector S13. Brightness filter capacitors connected to pins 2/3 and 4/5 are connected to the internal voltage controlled filter on each modulator board integrated circuit. Pins 1 and 2 of the balance board (S13) are connected to +15 and -15 VDC respectively and pins 6 and 7 are the differential current outputs of the modulator boards. These currents are summed simply by bussing them together and are converted to a single output voltage via amplifiers A1A and A1B and associated resistors. Capacitor C154 provides for RF interference suppression. The minus voltage supply to these amplifiers is bypassed by R5 and C153 to eliminate high frequency hash from entering the amplifiers on the minus voltage rail.

Referring to the modulator board schematic (Volume II), a composite d-c and 20kHz carrier signal is applied to pin 9 of the Polycom IC via C1 and to pin 10, the final decay control via R1 and CR1 when a key is depressed. Capacitor C2 is the contour capacitor which carries a voltage buffered internally and subsequently used to drive internal VCAs. The d-c step applied to pins 1 and 9 of the Polycom IC causes a step voltage to appear across contour capacitor C2. In addition, a-c voltage on the buss applied to pin 1 when a key is depressed causes a d-c voltage to also appear across contour capacitor C2. The applied composite keyboard signal operates in a manner described for the top left circuit board No. 7 (Section 4). Initial decay from the level appearing across the contour capacitor as a result of a d-c kick to the sustain level, determined by the amplitude of the a-c signal, will occur if current is injected on pin 10 of the Polycom IC either via key depression (through R1 and CR1) or via the foot sustain line on connector pin 12 and applied to pin 10 of the Polycom IC being held at ground potential.

The amount of brightness contour occuring via the transistor ladder contained in the Polycom IC connected via pins 1 thru 4 to capacitors on the mother board is determined by the voltage applied to pin 10 of the connector and thereby to pins 1 and 2 of the Polycom IC. The filter brightness voltage ranges between +1 and -10 VDC. When this voltage is -10 VDC, current is drawn down through the transistor ladder opening the filter and eliminating most of the filter brightness variation as the contour level changes. When filter brightness voltage is at 1 VDC, the filter opens in synchrony with the contour voltage appearing at contour capacitor C2. Pins 5 and 6 of the Polycom IC are open collector outputs and are bussed together for various modulator boards and applied to the differentiating amplifiers on the mother board. Pins 8 and 9 are the power supply busses to the Polycom IC.

The audio frequency drives applied to capacitors at the rear of the mother boards are differentiated by three capacitors and resistors on the modulator boards. For example, the audio drive coupled to pin 17 via a capacitor is differentiated by this capacitor and R10. The decay control of the contour is accomplished via a variable voltage applied to pin 16 of the connector and transmitted to the differentiated current via R9. In a similar manner, the capacitively coupled signal at pin 20 is biased by the voltage input on connector pin 13 to accomplish pulse width control.

Repeated depressions of a key with foot sustain applied can cause buildup of the contour voltage on C2 to unacceptably high levels. To prevent this, a limit voltage is applied to pin 11 of the connector setting an upper bound for the voltage developed on C2 via clamping diode CR2.

Sawtooth level control is implemented by a voltage applied to pin 15 of the connector which provides a current to pin 14 of the Polycom IC and to the capacitor on the mother board connected to pin 19 of the edge connector. Circuitry in the Polycom IC causes a sawtooth voltage to appear on pin 14 he IC.

The Polycom IC contains two modulator sections. In order to achieve balanced modulation under a variety of sawtooth level and pulse width conditions, a voltage derived from the balance board is supplied to pin 14, a balanced input which injects a control current to the Polycom IC via R7.

The balance board contains a Polycom IC driven from the common bussed sawtooth level and pulse width control lines for all modulator boards. In addition, a constant "key" drive is applied to pin 9 the IC. The outputs at pins 5 and 6 of the Polycom IC on the balance board are differentiated, integrated and checked for balance. Any imbalance is amplified and applied to the balance input. Thus the balance board examines itself for imbalance and corrects it in a feedback manner. Since the sawtooth and pulse width controls for the balance board and the 24 modulator boards are identical, the balance board corrects for balance in all modulator boards at the same time it is correcting for its own imbalance.

Referring to the balance board schematic (Volume II), the output voltage at pin 1 of A1A is an audio frequency waveform referenced to 10.0 VDC portional to the difference of the current flowing from output pins 5 and 6 of the Polycom in IC1. The d-c reference for this output is 10.0 VDC determined by the divider network comprised of R1 and R2. A 10.0 VDC bias voltage is also applied to integrator amplifiers A2A and A2B via divider network R6 and R7. If the output from the Polycom IC has a d-c imbalance, the d-c voltage on pin 1 of A1A will differ from 10.0 VDC.

This output voltage is applied to a fast integrator comprised of R4, R5, A2A and C1 and a slow integrator comprised of R8, C3 and A2B. When the imbalance of the Polycom in IC1 is large (for example, the result of changing waveshapes on the front panel control), the output on pin 1 of A2A deviates substantially enough from 10.0 VDC to forward bias either CR1 or CR2 driving the slow integrator via R10 at a rate 10 times faster than it can be driven via R8, the slow integration path. As the Polycom moves toward balance, diodes CR1 and CR2 no longer conduct and the only integration path is via R8. This integration waveshape has a long time constant (5 seconds) and the output of the integrator is returned to the balance input (IC1 pin 15) of the balance board Polycom IC through R9 and simultaneously applied to the common balance line (pin 14 of the modulator connector).

This combination of fast and slow integrators is used so that compensation circuitry may move rapidly toward balance when the waveforms are switched on the front panel via the fast integrator, but will contain very little residual ac because of the slow integrator time constant after having approached nearly perfect balance. Any residual ac on the output of A2B would couple into all of the modulator boards and cause output hash at the balance drive frequency, which is the same frequency as that applied to the 13th modulator board plugged into S14.

3.2 GENERAL SERVICING

Any malfunction associated with a particular modulator board may be isolated by exchange. For example, if a particular note appears to leak through with no note depressed, the associated modulator board can be quickly located and unplugged. If the leakage stops when the board is pulled and another board plugged into the bad location, then the fault is obviously on the modulator board itself. Malfunction of the balance board is indicated by "thumps" in the output when a key is depressed. Again this difficulty can be isolated by substituting a balance board from one of the other mother boards.

If a fault appears as the result of a defect on the mother boards, the top of the board should be examined for loose wires or damaged connectors before removal.

NOTE

The power supply output voltages must be checked and adjusted if necessary (refer to Table 8-1) prior to all troubleshooting procedures and after replacement of all malfunctioning parts.

3.3 REMOVAL

a. Demount the top board above the mother board by removing the four hold-down screws and two nuts attached to the hinges.

b. Remove the six hex standoffs securing the mother board and disconnect the four 6-pin keyboard connectors at the front of the mother board.

c. Remove the control and power line connectors at the ends of the board.

NOTE

If the mother board does not have to be entirely removed from the unit, the rear audio input connector on the divider board can be left connected. This is usually the case if the only difficulty is a bad capacitor. Do not remove the push-on connectors on the rear of the board.

d. Roll back the board for inspection of the bottom side.

e. If it is necessary to completely remove this board, disconnect it by using the connectors at the divider board.

3.4 TROUBLESHOOTING

Troubleshoot the mother modulator and balance boards using Table 3-1, the circuit description (paragraph 3.1) and part location and schematic diagrams in Volume II. Note that voltage levels and waveforms displayed on the schematic diagram are not absolute values as readings may vary between units. Once the problem is localized, check the suspected part by direct substitution if possible. Otherwise use a voltmeter or oscilloscope to determine the malfunctioning part.

TABLE 3-1
MOTHER BOARD TROUBLESHOOTING

PROBLEM	PROBABLE DEFECTIVE COMPONENT
* No decay/ constant sustain on percussive presets on one note	Faulty capacitor attached to pin 17
* Thumps on the output for all notes associated with a mother board	Balance board (S13)
Noisy mother board output	A1, N1, modulator board (remove sequentially to locate the faulty board)
Dead note	Modulator card or open connection to pin 1 of edge connector
Shorted supply, -5.5 or +4.85 VDC	Shorted trace on mother board, shorted Polycom IC (remove sequentially to locate faulty board)
* Unusually bright or fuzzy waveform on output of one note	Bad filter capacitor attached to pins 3/3 or pins 4/5 of edge connector
No sawtooth waveform on one note	Faulty capacitor connected to pin 18 or 19

* These problems may also be caused by poor contact between the modulator card and connector. Clean modulator card connector contacts.

TABLE 3-1
MOTHER BOARD TROUBLESHOOTING (Continued)

PROBLEM	PROBABLE DEFECTIVE COMPONENT
No rectangular sawtooth output	Faulty capacitor connected to pin 20
Note too loud or too soft	Replace modulator card or adjust according to schematic information on modulator cards (Volume II)
* Note bleeds through constantly	Replace modulator card
* These problems may also be caused by poor contact between the modulator card and connector. Clean modulator card connector contacts.	

TABLE 3-2
LOW MOTHER PRINTED CIRCUIT MBL BOARD 4 ASSEMBLY REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-040139-001	Low Mother Printed Circuit Board Assembly, consisting of:	
	906-042012-008	Socket, 8 Pin, DIP, AMP583640-1	1
	910-040311-001	Pin, Printed Circuit Board, 0.058, AMP60973-1	48
	996-040149-001	Modulator Printed Circuit Board Assembly (S1 thru S12 and S14 thru S25)	24 Ref
	996-040157-001	Balance Printed Circuit Board Assembly (S13)	1 Ref
A1	991-041102-001	Integrated Circuit, MC1458CP-1	1
C1,C7,C13, [illegible]9,C128,C129, C134,C135, C140,C141, C146,C147	946-040229-334	Capacitor, Polyester, 0.33uf	12
C2,C8,C14, C20,C25,C31, C37,C43	946-040229-274	Capacitor, Polyester, 0.27uf	8
C3,C9,C15, [illegible]C27,C33	946-040229-123	Capacitor, Polyester, 0.012uf	6
C4,C10, C16,C22	946-040229-683	Capacitor, Polyester, 0.068uf	4
C5,C6,C11, C12,C17,C18, C23,C24	946-040229-105	Capacitor, Polyester, 1.0uf	8
C26,C32,C38, C44,C49,C55, C61,C67	946-040229-224	Capacitor, Polyester, 0.22uf	8
C28,C34, C40,C46	946-040229-473	Capacitor, Polyester, 0.047uf	4
C29,C30,C35, C36,C41,C42, C47,C48	946-040229-824	Capacitor, Polyester, 0.82uf	8
C39,C45,C51, C[illegible]63,C69	946-040229-103	Capacitor, Polyester, 0.01uf	6
[illegible],C56,C62, C68,C73,C76, C82,C88,C94	946-040229-154	Capacitor, Polyester, 0.15uf	9

TABLE 3-2

LOW MOTHER PRINTED CIRCUIT MBL BOARD 4 ASSEMBLY REPLACEMENT PARTS LIST (Continued)

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
C52,C58, C64,C70	946-040229-393	Capacitor, Polyester, 0.039uf	4
C53,C54,C59, C60,C65,C66, C71,C72	946-040229-684	Capacitor, Polyester, 0.68uf	8
C74,C77,C83, C89,C95,C100, C106,C112, C118	946-040229-124	Capacitor, Polyester, 0.12uf	9
C75,C79,C85, C91,C97	946-040229-333	Capacitor, Polyester, 0.033uf	5
C78,C84,C90, C96,C102,C108	946-040229-822	Capacitor, Polyester, 0.0082uf	6
C80,C81,C86, C87,C92,C93, C98,C99	946-040229-474	Capacitor, Polyester, 0.47uf	8
C101,C107, C113,C119, C124,C130, C136,C142	946-040229-104	Capacitor, Polyester, 0.1uf	8
C103,C109, C115,C121	946-040229-273	Capacitor, Polyester, 0.027uf	4
C104,C105, C110,C111, C116,C117, C122,C123	946-040229-394	Capacitor, Polyester, 0.39uf	8
C114,C120, C126,C132, C138,C144	946-040229-682	Capacitor, Polyester, 0.0068uf	6
C125,C131, C137,C143	946-040229-823	Capacitor, Polyester, 0.082uf	4
C127,C133, C139,C145	946-040229-223	Capacitor, Polyester, 0.022uf	4
C148 thru C153	947-040200-103	Capacitor, Disc, 0.01uf	6
C154	947-042020-102	Capacitor, Disc, 0.001uf	1
CR1,CR2	919-042019-001	Diode, Rectifier, 1N4004	2
N1	949-040219-001	Resistor Network (R1 thru R3)*	1
P41,P43 thru P46	910-040303-006	Header, Printed Circuit, 6 Pin, Keyed (0.15 Centers), AMP640242-6	5
P42	910-040306-007	Header, Printed Circuit, 7 Pin, Keyed (0.15 Centers), AMP640245-1	1
R4	852-312047-001	Resistor, 4.7 Ohm, ± 5%, 1/4W	1
R5	852-312102-001	Resistor, 1K Ohm, ± 5%, 1/4W	1
S1 thru S25	910-041746-020	Connector, 20 Pin, AMP530403-1	25

* See Schematic Diagram for Resistor Values (± 5%, 1/4W)

TABLE 3-3
MEDIUM MOTHER PRINTED CIRCUIT MBM BOARD 5 ASSEMBLY REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-040143-001	Medium Mother Printed Circuit Board Assembly, consisting of:	
	906-042012-008	Socket, 8 Pin, DIP, AMP583640-1	1
	910-040311-001	Pin, Printed Circuit Board, 0.058, AMP60973-1	48
	996-040149-001	Modulator Printed Circuit Board Assembly (S1 thru S12, S14 thru S25)	24 Ref
	906-042012-008	Socket, 8 Pin, DIP, AMP583646-1	1
	996-040157-001	Balance Printed Circuit Board Assembly (S13)	1 Ref
A1	991-041102-001	Integrated Circuit, MC1458CP-1	1
C1,C7,C13,C19, C128,C129, C134,C135, C140,C141, C146,C147	946-040229-823	Capacitor, Polyester, 0.082uf	12
C2,C8,C14, [illegible],C25,C31, C37,C43	946-040229-683	Capacitor, Polyester, 0.068uf	8
C3,C9,C15, C21,C27,C33	946-040229-562	Capacitor, Polyester, 0.0056uf	6
C4,C10,C16, C22	946-040229-153	Capacitor, Polyester, 0.015uf	4
C5,C6,C11, C12,C17,C18, C23,C24	946-040229-274	Capacitor, Polyester, 0.27uf	8
C26,C32,C38, C44,C49,C55, C61,C67	946-040229-473	Capacitor, Polyester, 0.047uf	8
C28,C34, C40,C46	946-040229-123	Capacitor, Polyester, 0.012uf	4
C29,C30,C35, [illegible],C41,C42, C47,C48	946-040229-224	Capacitor, Polyester, 0.22uf	8
C39,C45,C51, C57,C63,C69, C127,C133, C139,C145	946-040229-472	Capacitor, Polyester, 0.0047uf	10
C50,C56,C62, C68,C73,C76, C82,C88,C94	946-040229-393	Capacitor, Polyester, 0.039uf	9
C52,C58, C64,C70	946-040229-103	Capacitor, Polyester, 0.01uf	4
C53,C54,C59, C60,C65,C66, C71,C72	946-040229-154	Capacitor, Polyester, 0.15uf	8

TABLE 3-3
MEDIUM MOTHER PRINTED CIRCUIT MBM BOARD 5 ASSEMBLY REPLACEMENT PARTS LIST (Continued)

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
C74,C77,C83, C89,C95,C100, C106,C112, C118	946-040229-333	Capacitor, Polyester, 0.033uf	9
C75,C79,C85, C91,C97	946-040229-822	Capacitor, Polyester, 0.0082uf	5
C78,C84,C90, C96,C102, C108	946-040229-392	Capacitor, Polyester, 0.0039uf	6
C80,C81,C86, C87,C92,C93, C98,C99	946-040229-124	Capacitor, Polyester, 0.12uf	8
C101,C107, C113,C119, C124,C130, C136,C142	946-040229-273	Capacitor, Polyester, 0.027uf	8
C103,C109, C115,C121	946-040229-682	Capacitor, Polyester, 0.0068uf	4
C104,C105, C110,C111, C116,C117, C122,C123	946-040229-104	Capacitor, Polyester, 0.1uf.	8
C114,C120, C126,C132, C138,C144	946-040229-332	Capacitor, Polyester, 0.0033uf	6
C125,C131, C137,C143	946-040229-223	Capacitor, Polyester, 0.022uf	4
C148 thru C153	946-040200-103	Capacitor, Disc, 0.01uf	6
C154	947-042020-102	Capacitor, Disc, 0.001uf	1
CR1,CR2	919-042019-001	Diode, Rectifier, 1N4004	2
N1	949-040219-001	Resistor Network (R1 thru R3)	1
P51,P53 thru P56	910-040303-006	Header, Printed Circuit, 6 Pin, Keyed (0.15 Centers), AMP640242-6.	5
P52	910-040306-007	Header, Printed Circuit, 7 Pin, Keyed (0.15 Centers), AMP640245-1	1
R4	852-312047-001	Resistor, 4.7 Ohm, ±5%, 1/4W	1
R5	852-312102-001	Resistor, 1K Ohm, ±5%, 1/4W	1
S1 thru S25	910-041746-020	Connector, 20 Pin, AMP530403-1	25

TABLE 3-4
HIGH MOTHER PRINTED CIRCUIT MBH BOARD 6 ASSEMBLY REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-040145-001	High Mother Printed Circuit Board Assembly, consisting of:	
	906-042012-008	Socket, 8 Pin, DIP	1
	910-040311-001	Pin, Printed Circuit Board, 0.058, AMP60973-1	48
	996-040149-001	Modulator Printed Circuit Board Assembly (S1 thru S12 and S14 thru S24), See Table 3-5	23 Ref
	996-040157-001	Balance Printed Circuit Board Assembly, (S13), See Table 3-6	1 Ref
	996-040635-001	Bypass Filter Printed Circuit Board Assembly (S25), See Table 3-7	1 Ref
A1	991-041102-001	Integrated Circuit, MC1458CP-1	1
C1,C7,C13,C19, C128,C129, C134,C135, C140,C141, C146,C147	946-040229-223	Capacitor, Polyester, 0.022uf	12
C2,C[illegible] C14,C20, C2[illegible]1,C37, C43	946-040229-153	Capacitor, Polyester, 0.015uf	8
C3,C9,C15,C21, C27,C33,C52, C58,C64,C70	946-040229-272	Capacitor, Polyester, 0.0027uf	10
C4,C10,C16,C22	946-040229-392	Capacitor, Polyester, 0.0039uf	4
C5,C6,C11,C12, [illegible]7,C18,C23, C24	946-040229-683	Capacitor, Polyester, 0.068uf	8
C26,C32,C38, C44,C49,C55, C61,C67	946-040229-123	Capacitor, Polyester, 0.012uf	8
C28,C34,C40, C46	946-040229-332	Capacitor, Polyester, 0.0033uf	4
C29,C30,C35, C[illegible]1,C42, C47,C48	946-040229-473	Capacitor, Polyester, 0.047uf	8
C39,C45,C51, C57,C63,C69, C75,C79,C85, C91,C97	946-040229-222	Capacitor, Polyester, 0.0022uf	11
C50,C56,C62, C68,C73,C76, C82,C88,C94	946-040229-103	Capacitor, Polyester, 0.01uf	9
C53,C54,C59, C60,C65,C66, C71,C72	946-040229-393	Capacitor, Polyester, 0.039uf	8
C74,C77,C83, C89,C95,C100, C106,C112, [illegible]118	946-040229-822	Capacitor, Polyester, 0.0082uf	9

TABLE 3-4
HIGH MOTHER PRINTED CIRCUIT MBH BOARD 6 ASSEMBLY REPLACEMENT PARTS LIST (Continued)

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
C78,C84,C90, C96,C102,C108	946-040229-182	Capacitor, Polyester, 0.0018uf	6
C80,C81,C86, C87,C92,C93, C98,C99	946-040229-333	Capacitor, Polyester, 0.033uf	8
C101,C107, C113,C119, C124,C130, C136,C142	946-040229-682	Capacitor, Polyester, 0.0068uf	8
C103,C109, C114,C115, C120,C121, C126,C132, C138,C144	946-040229-152	Capacitor, Polyester, 0.0015uf	10
C104,C105, C110,C111, C116,C117, C122,C123	946-040229-273	Capacitor, Polyester, 0.027uf	8
C125,C131, C137,C143	946-040229-472	Capacitor, Polyester, 0.0047uf	4
C127,C133, C139,C145	946-040229-102	Capacitor, Polyester, 0.001uf	4
C148 thru C153	947-040200-103	Capacitor, Disc, 0.01uf	6
C154	947-042020-102	Capacitor, Disc, 0.001uf	1
CR1,CR2	919-042019-001	Diode, Rectifier, 1N4004	2
N1	949-040219-001	Resistor Network (R1 thru R3)	1
P61,P63 thru P66	910-040303-006	Header, Printed Circuit, 6 Pin, Keyed (0.15 Centers), AMP640242-6	5
P62	910-040306-007	Header, Printed Circuit, 7 Pin, Keyed (0.15 Centers), AMP640245-1	1
R4	852-312047-001	Resistor, 4.7 Ohm, ± 5%, 1/4W	1
R5	852-312102-001	Resistor, 1K Ohm, ± 5%, 1/4W	1
S1 thru S25	910-041746-020	Connector, 20 Pin, AMP530403-1	25

TABLE 3-5
MODULATOR PRINTED CIRCUIT MOD$_n$ BOARD ASSEMBLY REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-040149-001	Modulator Printed Circuit Board Assembly consisting of:	
	916-040636-001	Strip, Grommet, 15 in.	1
C1	946-041978-124	Capacitor, Polyester, 0.12uf, 50V, ± 10%	1
C2	946-040226-105	Capacitor, Metalized Mylar, 1uf, 64V	1
CR1,CR2	919-041075-001	Diode, 1N4148 or Alternate 1N914	2

TABLE 3-5

MODULATOR PRINTED CIRCUIT MOD_n BOARD ASSEMBLY REPLACEMENT PARTS LIST (Continued)

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
IC1	949-040077-000	Integrated Circuit, Polycom V	1
R1,R2,R3	852-312104-001	Resistor, 100K Ohm, ±5%, 1/4W	3
R4	852-312242-001	Resistor, 2.4K Ohm, ±5%, 1/4W	1
R5	852-312474-001	Resistor, 470 Ohm, ±5%, 1/4W	1
R6	853-222432-021	Resistor, 24.3K Ohm, ±1%, 1/4W	1
R7	852-312333-001	Resistor, 33K Ohm, ±5%, 1/4W	1
R8	852-312244-001	Resistor, 240K Ohm, ±5%, 1/4W	1
R9	852-312123-001	Resistor, 12K Ohm, ±5%, 1/4W	1
R10,R11	852-312243-001	Resistor, 24K Ohm, ±5%, 1/4W	2
R12	852-312102-001	Resistor, 1K Ohm, ±5%, 1/4W	1
R13	853-224992-021	Resistor, 49.9K Ohm, ±1%, 1/4W	1
R14	923-042777-001	Resistor, Selected, 270K Ohm to 4.7 Megohm	1

TABLE 3-6

BALANCE PRINTED CIRCUIT BAL BOARD ASSEMBLY REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-040157-001	Balance Printed Circuit Board Assembly, consisting of:	
	906-040307-008	Socket, 8 Pin, SIL IC	2
	916-040636-001	Strip, Grommet, 15 in.	1
A1,A2	991-041084-001	Integrated Circuit, Dual Operational Amplifier, LM358N	2
C1	946-040229-104	Capacitor, Polyester, 0.1uf	1
C2,C4	947-040200-103	Capacitor, Disc, 0.01uf	2
C3	946-040231-002	Capacitor, Tantalum, 10uf, ±10%, 25V	1
C5	947-042020-501	Capacitor, Disc, 500pf	1
CR1,CR2	919-041075-001	Diode, 1N4148, Alt, 1N914	2
IC1	949-040077-001	Integrated Circuit, Polycom II, DM8670	1
N1	949-040232-001	Resistor Network, Balance No. 1 (R1 thru R7)	1
N2	949-040233-001	Resistor Network, Balance No. 2 (R13 thru R15)	1
N3	949-040234-001	Resistor Network, Balance No. 3 (R9 thru R12 and R18 thru R20)	1
R8	852-312514-001	Resistor, 510K Ohm, ±5%, 1/4W	1
R16	852-312472-001	Resistor, 4.7K Ohm, ±5%, 1/4W	1
R17	852-312244-001	Resistor, 240K Ohm, ±5%, 1/4W	1
XIC1	906-040307-008	Socket, Integrated Circuit, Silicon, 8 Pin, AMP1-583773-5	2

TABLE 3-7

BYPASS FILTER PRINTED CIRCUIT BY BOARD ASSEMBLY REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-040635-001	Bypass Filter Printed Circuit Board Assembly, consisting of:	
	916-040636-001	Strip, Grommet, 1.5 in.	1
	947-042024-005	Wire, 24 gauge	AR
C1	945-040209-012	Capacitor, Aluminum, Electrolytic, 200uf, 25V	1

SECTION 4
BOARD 7
REFERENCE AND MODULATION OSCILLATOR, WAVESHAPE AND KEYBOARD CONTROL
TL

4.1 CIRCUIT DESCRIPTION

The reference and modulation oscillator waveshape and keyboard control printed circuit board assembly (TL) contains the following major sections: (1) three modulation oscillators with associated voltage control amplifiers; (2) precision voltage controlled oscillators (VCO) with associated phase lock circuitry; (3) drive level limit control; (4) sawtooth level control; (5) decay control; (6) pulse width control; and (7) polyphonic keyboard buss control. (Refer to Volume II for schematic diagrams.)

The three modulation oscillators are used to modify the pulse width and frequencies of reference oscillators No. 1 and 2. The pulse width modulation oscillator is comprised of A1A, Q1, A2, A3B, A3A and associated components. The rate of this modulation oscillator is controlled by current injected on the PWMRN line causing the output of A1A to go negative translating the input current to the bias input terminal of the CA3080E, pin 5 of A2.

Amplifier A1A is used to provide a zero potential summing node for currents injected on the PWMRN line and, as mentioned, translates this current via the high impedance output at the collector of Q1. The CA3080E, A2, is used as a current switch, whereby current flowing into the bias input terminal (pin 5) appears at the output (pin 6) in either positive or negative polarity determined by drive polarity on pin 3, the positive input of A2. The current output of A2 causes a linear ramp voltage on capacitor C1 whose voltage is buffered by amplifier A3B and applied to the negative input of a Schmitt trigger comprised of A3A, R9 and R10. Positive feedback from the output of A3A occurs via divider R9 and R10 to the positive input (pin 3) of A3A. The output on pin 1 of A3A swings from approximately +14 to -14 volts and applies approximately ±2.5 VDC to the positive input of both A3A and current switch A2. At the time the output of A3A swings to one limit, the current direction on the output of A2 is reversed and the linear voltage ramp on C1 is thereby reversed. This action results in a triangular wave appearing on the output of A3B.

Operation of reference oscillators No. 1 and 2, comprised of A1B, Q2, A4, A5B and A5A and A6A, Q3, A7, A8B and A8A, respectively, is identical to that of the pulse width modulation oscillator. The output from each reference oscillator is a 5 volt peak-to-peak triangular wave.

The triangular wave output of the pulse width modulation oscillator is applied to two VCAs via divider networks R17/R18 and R23/R24. These VCAs utilize current controlled CA3080s as multipliers. Since the output of the CA3080s is proportional to the product of the input voltage and the bias current flowing into pin 5, current injected on the PWMHN and PWMLN lines control the amount of triangular current appearing at the outputs (pin 6) of A9 and A11. Currents on these two input control lines are translated to the bias input terminals of the CA3080s via the current level translator circuits comprised of A10A/Q4 and A10B/Q5. Operation of these current level translators is identical to that of A1A and Q1 described previously. The output currents from amplifiers A9 and A11 modulate the control lines on the mother boards to determine the pulse width for the upper four and lower two octave sections of the keyboard, respectively. The control currents on the PWMHN and PWMLN lines are determined by the front panel controls and pulse width modulation high and low balance trim pots. R15 and R21 cancel any effects of input offset voltages of VCAs A9 and A11. The voltages applied to these VCAs are divided down by a factor of 100 to 1 by R17/R18 and R23/R24 networks so that the multiplier circuits are linear.

The output of reference oscillator No. 1 modulation oscillator at pin 7 of A5B is applied to a voltage controlled amplifier comprised of A13 and associated components. Operation of this circuit is identical to that described for pulse width modulation and oscillator modulation where balance trim pot R30 is used to cancel any input offset voltage of A13. Current injected on the POFMIN line controls the amount of frequency modulation current on the output pin of A13 which is applied to reference oscillator No. 1 summing amplifier A16A.

The triangular output voltage of A8B is applied to voltage controlled amplifiers A14 and A15 and are used to either phase-modulate or frequency-modulate reference oscillator No. 2. The output modulation current at pin 6 of A15 is applied to frequency control summing amplifier A18A for reference oscillator No. 2.

Current injected on the POFM2N line is applied to frequency modulation amplifier A15 via the current translation circuit comprised of A6B, Q7 and R43. This drive current is divided between the two amplifiers by R40 and R42, providing twice as much current to amplifier A15 as compared to amplifier A14. The current injected on the POFM2N line thus controls both the amount of frequency and phase modulation.

The output at pin 6 of A14 is applied to the negative input of A19 and a load resistor comprised of phase modulation balance trim pot R100 and resistor R99, the other end of which is connected to the sawtooth output of reference oscillator No. 1.

Operation of the two reference oscillators are identical, therefore only one will be described. The sawtooth outputs of the two reference oscillators are generated at pins 6 of A20 and A22 with 2 usec pulses appearing at pins 6 of amplifiers A21 and A23. Each reference oscillator is comprised of three subsections: (1) input summing and biasing networks; (2) an exponential and current converter; and (3) the oscillator section itself.

The input summing and biasing sections are comprised of amplifiers A16A/A16B and A18A/A18B.

Tuning control enters on the POFT line and is applied simultaneously to summing amplifiers A16A and A18A thru current sharing resistors R48 and R72 and thru R98 connected to the FINE TUNE control. BEAT rate control is introduced on the POBT line and is applied to reference oscillator No. 2 via R73. Control voltage RIBR from the pitch controller is applied to both oscillators via dead band diodes CR1 and CR2 and feed resistor R96. External oscillator control enters via the OSEXC line and is connected to both oscillators via R97. The various sources which control oscillator frequency are summed via A16A and applied to current converter drive amplifier A16B. Oscillator 1 range trim pot R51 is used for range tuning the reference oscillator and oscillator 1 scale trim pot R54 is used to trim the scale factor or frequency interval caused by various pitch control inputs and match the scaling of the two reference oscillators. The output of scaling amplifier A16B is applied to a heated differential transistor pair in IC1 via resistor R55. The transistor pair in IC1 is maintained at a constant temperature by internal circuitry. Current through the right hand transistor is constant. The collector of this transistor is maintained by A17B and associated components at a constant 5 volt reference potential which is also applied to the positive input of A17B via a network comprised of R63, R64 and R66 and input resistor R60. A17B maintains a 5 volt potential on pin 4 of IC1 via protection resistor R57 connected to the emitters. R59 and C11 are a high frequency roll-off network used to prevent oscillation. The voltage applied to pin 1 of IC1 causes an exponential current to be applied to the negative input of oscillator integrator amplifier A20. The FET switch in IC3 across capacitors C13 and C14 is normally open. Current drawn from the negative input of A20 causes the positive going ramp waveform on the output which is applied to the positive input of comparator A21, also supplied by a 5 volt reference potential via divider R63, R64 and R66.

Fast positive feedback provided by C17 and R6 to the positive input of A21 forces the output of A21 to switch very rapidly from 0 to 15 VDC switching the FET across C13 and C14 on. This action causes the voltage across C13 and C14 to drop to zero resetting the sawtooth waveform. The output of A20 drops to zero resetting the comparator output at pin 6 of A21 to zero, turning off the FET contained in IC3. This cyclical action results in a repetitive sawtooth of 5 volts amplitude on pin 6 of A20. Resistor R62 provides reset time compensation of the integrator so that the output frequency will be a linear function of current flowing into the negative input of A20. Capacitor C12 provides high frequency compensation to prevent oscillation and the output reset pulse duration on pin 6 of A21 is 2.0 usec.

The 2.0 usec output of reference oscillator No. 1 from pin 6 of A21 is applied through R69 to the phase comparator section of phase-locked loop IC6, a CMOS CD4046. IC6 compares the frequency of pulses from reference oscillator No. 1 and the return divided down clock line CLKC1 (from the frequency divider board) and provides a control voltage on line CLKC2 connected to a high frequency oscillator contained on the high frequency oscillator board.

The high frequency oscillator is slaved in a manner such that its divided down signal phase is exactly equal to that of reference oscillator No. 1.

In a similar manner, the output pulse from reference oscillator No. 2 (on pin 6 of A23) is applied to a phase comparator in IC7 via G3, G4 and R95, the active path when the instrument is in the FREE mode, in which case the two high frequency oscillator sections are independently synchronized to their respective reference oscillators. However, when the instrument is in the LOCK mode, the phase comparator in IC7 is fed from the output of a phase modulator circuit via G1 and G4. This phase modulator circuit is comprised of A19, load resistor R99 and phase modulation balance trim pot R100. Switching between the LOCK and FREE modes is accomplished via the SPLFR line which drives a level translator followed by an inverter in IC4 which drives gates G1 and G2 of IC5. When the SPLFR line is a “1” (LOCK mode), output pin 12 of IC4 is positive inhibiting G3 via inverter G2. At the same time, G1 is enabled as is the upper FET transistor in IC3 enabling a variable width pulse from A19 to be coupled to G1 and subsequently to IC7 via G4.

A 2.5 volt potential is applied to the positive input of A19 via a resistor divider network comprised of R63, R64 and R66. The potential appearing at pin 2, the negative input of A19, is the sum of the 5 volt sawtooth from reference oscillator No. 1 and the triangular phase modulation signal from VCA A14 described previously. A19 operates as a comparator at a threshold voltage of 2.5 volts and triggers at a variable point along the sawtooth depending upon the amplitude of the phase modulation current from A14. This action results in an output with a delay or advance from the leading edge of the reference signal (which is frequency locked to reference oscillator No. 1 but phase modulated). Since the phase comparator in IC7 triggers on the leading edge, the phase lock loop for the rank 2 oscillator system in the LOCK mode is synchronized but phase modulated relative to reference oscillator No. 1.

The 2 usec pulses from the two reference oscillators are applied to the BEAT rate indicator circuit comprised of IC8, Q8, front panel LED L1 and associated components. The reference frequency pulses are buffered by gates G5 and G6 and applied to a cross-coupled latch comprised of G7 and G8. This coupling scheme results in a flip-flop output on pin 3 of IC8 of a variable duty cycle depending upon the relative phase of reference oscillators No. 1 and 2. This pulse width modulated signal is applied through a simple filter circuit comprised of R135 and C26 and applied to the transistor amplifier comprised of R136 and Q8 which drives the front panel LED via limit resistor R137. This circuit generates a blink rate equal to the frequency difference between the two reference oscillators.

The drive level limit circuit is comprised of A24B, A24A and associated resistors. Current injected on the PLCMN line causes the output of A24A to vary between approximately -3 and 0 VDC. Trim pot R108 adjusts the drive level limit to the proper bias. The drive level limit output on pin 1 of A24A is applied to the contour capacitors contained on the mother board modulator boards via a diode. This diode clamp prevents overdrive of the contour signals on the modulator boards.

The sawtooth level output generated on the modulator boards is controlled via buss lines SWLBL, SWLBM and SWLBH, the control lines for the low, medium and high mother boards, respectively. These buss lines are driven by two sawtooth level circuits comprised of A25B, A25A, CR5, CR6 and associated components. Control currents for the sawtooth level from the front panel are injected on lines PSWLN and PSWHN and applied to amplifiers A25B and A25A. Sawtooth level high and low trim pots R114 and R120 provide bias control for setting the zero sawtooth level accurately. When the sawtooth waveform is switched off for either the lower or upper keyboard via the keyboard waveshape digital controls on the front panel, the appropriate control line, either SKO1H or SKO1L, is positive. This action causes current to be supplied to the sawtooth level amplifiers via CR5/R116 and CR6/R122 driving the amplifier outputs hard negative (about -12 VDC).

Decay rate control of the contour generators contained on the mother board modulator boards is accomplished via the KBLDB, KBMDB and the KBHDB buss lines which are connected to the low, medium and high mother boards, respectively. Currents provided by the front panel control and injected on lines PKDLN and PKDHN generate control voltages on buss lines via amplifiers comprised of A26A, A26B and A27, respectively. Decay low and medium set trim pots R126 and R127 adjust the operating points of these control circuits for the low and high keyboard sections, respectively. Decay high set trim pot R132 allows for a small amount of offset between control voltages applied to the medium and high mother boards.

Pulse Width Control of the rectangular waveshape generated by the modulator boards is accomplished via the PWSLB, PWSMB and PWSHB buss lines for the low, medium and high mother boards, respectively. Currents provided by the front panel control and injected on the PSLN, PSMN and PSHN lines determine the voltages appearing on these buss lines. Pulse width trim pots R152, R145 and R138 set the operating points for the low, medium and high control lines, respectively. In addition, pulse width modulation currents are coupled to input amplifiers via resistors R144, R151 and R158. Resistors R144 and R151 set a 2 to 1 division of current provided by pulse width modulation VCAs resulting in twice as much pulse width modulation on the high mother board as on the medium mother board.

The polyphonic keyboard system is comprised of two buss lines (highest level, KBHLB and lowest level, KBLLB) with 71 parallel RC networks connected between them. The lowest level buss line is voltage driven while the highest level line is driven by a current source. The signal appearing on the lowest level buss is a composite d-c baseline and a 20 kHz carrier pulse train of variable width and variable height pulses. The height of the carrier pulse train determines the sustain level in the modulator boards while the carrier pulse width determines the attack time and the d-c level determines the amount of dynamic effect. Refer to Figure 4-1.

Gate G9 of IC9, R178 and C34 comprise a 20 kHz oscillator to drive gate G10 serving as a current shunt across intergrating capacitor C35. Capacitor C35 is shorted to ground during approximately 40 percent of the 20 kHz duty cycle. When open collector gate G10 goes off, current provided via the collector of Q10 causes the voltage to rise across C35 until gate G12 of IC9 fires via Darlington buffer Q13. When G12 fires, it shuts down gate G13 of IC10 just previously turned on via gate G11. The greater the current applied to C35, the more rapidly G12 fires producing a shorter pulse. If transistor Q10 is cut off so that no integration current is supplied to C35, G13 goes on and off as G9 goes on and off via gate G11. Thus, this circuit can never go to zero pulse width. The output of NAND gate G13 of IC10 is applied to open collector inverter G14 resulting in a variable width open collector time on pin 11 connected to the collector of current source transistor Q12. Control of this pulse width is accomplished by a current from a front panel control injected from the PKATN line and applied to amplifier A32A. This amplifier in turn drives differential pair Q10 and Q11 providing an exponential current to integration capacitor C35. The operation point of this circuit may be varied with attack set trim pot R165 to compensate for transistor offsets.

The SUSTAIN LEVEL is determined by current from the front panel control injected on the PKBSN line and applied to a current converter circuit comprised of A32B, Q12 and associated resistors. This circuit provides an approximate 20 to 1 current multiplication determined by the ratio of R175 and R177 and is biased via sustain level set trim pot R174. The multiplied current is applied to current level translator transistor Q15 which translates this current to R189, the lowest level load resistor. However, this current is shunted at a 20 kHz rate by open collector gate G14 of IC10 for a duty cycle determined by the attack time controls. Thus the voltage appearing on load resistor R189 is a pulse whose height is determined by sustain current and whose width is determined by attack current.

The degree of keyboard dynamics is determined by a current provided by the front panel DYN control and is injected on the PKDYN line connected to a current multiplier circuit comprised of A31A, Q14 and associated resistors. This multiplied current is applied to the previously mentioned load resistor R189 to introduce d-c offset. Lowest level trim pot R182 provides for lowest d-c operating level adjustment. The composite voltage on load resistor R189 is applied to emitter follower Q16 and R190 which drives the lowest level buss via R192.

The highest level buss, KBHLB, is coupled to the lowest level buss, KBLLB, with 71 parallel RC networks and presents an effective load resistance of approximately 330 ohms paralleled with 15 microfarads. The highest level detector and regulator circuit comprised of A31B, Q9, CR9, CR10 and associated components is a regulated current source which maintains peak voltage on the highest level (KBHLB) buss at approximately 3.0 VDC. The minus input of A31B is biased at +2.3 volts via a divider network comprised of R161 and R160. Feedback resistor R162 sets an amplifier gain of 100 with respect to signals appearing on the positive input and the output of A31B drives the current source comprised of R163 and Q9. If, for example, the highest level buss voltage is significantly below +3.0 VDC, then the positive input of A31B is pulled toward ground via R164. The resulting voltage difference on the input of A31B is amplified by a gain of 100 which drives the output of A31B negative, turning on the current source. The current source, comprised of R163 and Q9, supplies current via CR9 to the highest level buss. The voltage on the highest level buss rises until voltage on the input of A31B is 2.3 volts. This occurs when voltage on the highest level buss is approximately 3

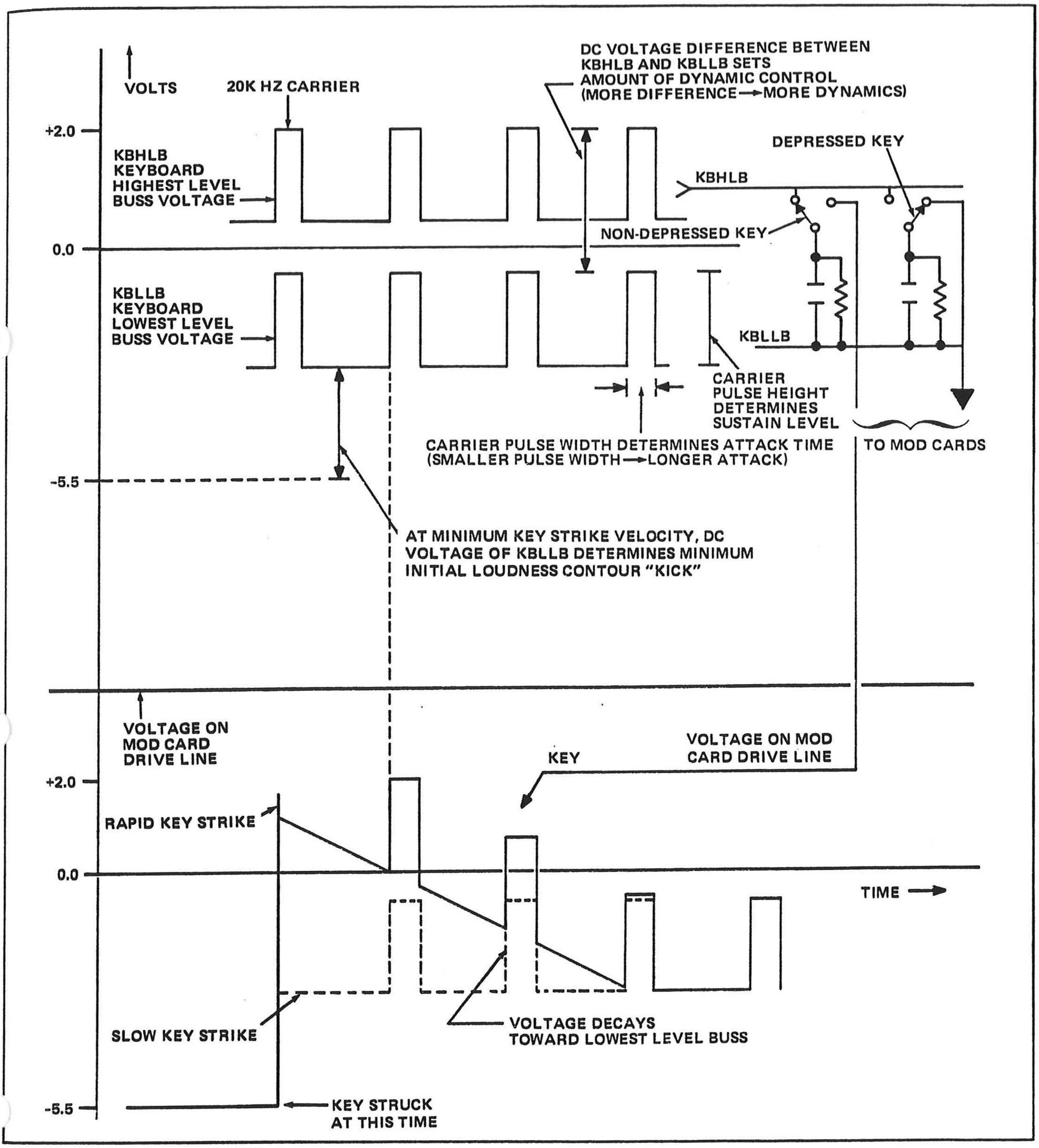

VOLTS
20K HZ CARRIER
+2.0
0.0
-5.5
KBHLB
KEYBOARD
HIGHEST LEVEL
BUSS VOLTAGE
KBLLB
KEYBOARD
LOWEST LEVEL
BUSS VOLTAGE
DC VOLTAGE DIFFERENCE BETWEEN
KBHLB AND KBLLB SETS
AMOUNT OF DYNAMIC CONTROL
(MORE DIFFERENCE→MORE DYNAMICS)
DEPRESSED KEY
KBHLB
NON-DEPRESSED KEY
KBLLB
CARRIER
PULSE HEIGHT
DETERMINES
SUSTAIN LEVEL
TO MOD CARDS
CARRIER PULSE WIDTH DETERMINES ATTACK TIME
(SMALLER PULSE WIDTH→LONGER ATTACK)
AT MINIMUM KEY STRIKE VELOCITY, DC
VOLTAGE OF KBLLB DETERMINES MINIMUM
INITIAL LOUDNESS CONTOUR "KICK"
VOLTAGE ON
MOD CARD
DRIVE LINE
+2.0
0.0
-5.5
RAPID KEY STRIKE
KEY
VOLTAGE ON MOD
CARD DRIVE LINE
TIME →
SLOW KEY STRIKE
VOLTAGE DECAYS
TOWARD LOWEST LEVEL BUSS
KEY STRUCK
AT THIS TIME

FIGURE 4-1 POLYMOOG AND POLYMOOG KEYBOARD CONTROL CIRCUITS

VDC because of an additional voltage drop across diode CR10. If, for example, the lowest level control current is increased, causing the potential across Q15 and resistor R189 to rise and thereby causing the lowest level voltage to rise, the voltage applied to the positive input of A31B begins to rise shutting down the current source via Q9 lowering the voltage on the highest level buss. The maximum keyboard dynamic effect occurs when the voltage difference between the highest level and lowest level busses is at maximum. As voltage on the lowest level buss is increased, this voltage difference decreases. When a key is depressed, the associated RC network on the keyboard is detached from the highest level buss and, after a transit time (inversely proportional to the velocity) contacts the key drive input connected to the associated modulator board. The original d-c voltage difference between the lowest and highest level busses is applied to the RC network and decays toward zero with a time constant of 5 msec. The more rapidly a key is depressed, the higher this voltage difference and the higher the voltage "kick" applied to the associated modulator board. When the lowest level voltage is high to start with, the voltage difference between the lowest and highest level busses is small and the d-c voltage kick to the modulator board is large but it does not change with velocity because there is no voltage difference across the parallel RC network to begin with. In this case, a fixed kick is applied to the modulator board and there is no dynamic effect.

Both sustain level drive and lowest level drive apply current to lowest level load resistor R189 raising its potential. However raising both of these drives to a maximum could cause the peak voltage on the lowest level output to exceed the voltage set by the highest level detector and regulator. This condition would cause the keyboard to have a reverse dynamic effect. To eliminate this "pile up" problem and yet maintain the ability of either the lowest level drive or the sustained level drive to achieve maximum drive when the other is a minimum, the peak voltage of the lowest level buss is regulated to a maximum voltage of +0.7 VDC by the lowest level detector and regulator circuitry comprised of CR11, A33, CR12 and associated components. Diode CR11, C38 and R192 comprise a peak detector driving an amplifier with a gain of 47 comprised of A33, R193 and R191. Additional smoothing of the peak detector output is accomplished by C39. If the voltage on the lowest level buss (emitter of Q16) begins to exceed 0.7 VDC, the output of A33 swings negative with a gain of 47. This voltage provides current via CR12 and R194 to lowest level drive amplifier A31A shutting down current delivered via the collector of Q14 to lowest level load resistor R189 and back to the lowest level buss via emitter follower Q16. As mentioned previously, this feedback prevents overdrive of the lowest level output buss.

4.2 GENERAL SERVICING

The most sensitive components are the CA3080s and CMOS ICs which plug into sockets for easy replacement. Improper operation of a particular circuit block may be due to either a malfunction on the board itself or to an improper control signal entering the board. In many cases, this can be determined simply by removing the connector which carries the input control signal. All connectors may be removed from the left hand board and the unit turned on (except power supply connector P710 in serial numbers up to 2350 as this connector carries the sense lines for the 15 volt buss supply).

NOTE

The power supply output voltages must be checked and adjusted if necessary (refer to Table 8-1) prior to all troubleshooting and alignment procedures and after replacement of all malfunctioning parts. Whenever a CA3080 integrated circuit is replaced, repeat alignment of the specific circuit affected as indicated in paragraphs 4.4 for Polymoog or 4.5 for Polymoog Keyboard.

4.3 ALIGNMENT

All trim adjustments for the top left board are available by removing the top cover. (Refer to Figure 4-2).

4.4 POLYMOOG TUNING AND ADJUSTMENT

NOTE

Before performing any adjustment, the following power supply voltages must be checked first with at least a 3-1/2 digit digital voltmeter: +15V, -15V, +5V, +4.85V and -5.5V.

a. PULSE WIDTH MODULATION HIGH BALANCE ADJUSTMENT

1. Depress ⊓⊔⊓ SHAPE/MODULATION VAR pushbutton and place all five slide controls full up.

2. Short pin 5 of A3B to ground. Connect DVM to pin 6 of A9 and adjust trim pot R15 for an indication of 0.0 ± 0.02 VDC.

3. Remove short at pin 5 of A3B and disconnect voltmeter.

b. PULSE WIDTH MODULATION LOW BALANCE ADJUSTMENT

1. Depress ⊓⊔⊓ SHAPE/MODULATION VAR pushbutton and place all five slide controls full up.

2. Short pin 5 of A3B to ground. Connect DVM to pin 6 of A11 and adjust trim pot R21 for 0.0 ± 0.010 VDC.

3. Remove short at pin 5 of A3B and disconnect DVM.

c. OSCILLATOR 1 MODULATION AMOUNT ADJUSTMENT

1. Depress /|/| FM VAR pushbutton and place all four slide controls full up.

2. Short pin 5 of A5B to ground. Connect DVM to pin 6 of A13 and adjust trim pot R30 for an indication of 0.0 ± 0.005 VDC.

d. FM 2 MODULATION AMOUNT ADJUSTMENT

1. Depress /|/| FM VAR pushbuttons and lace all four slide controls full up.

2. Short pin 5 of A8B to ground. Connect DVM to pin 6 of A15 and adjust trim pot R38 for an indication of 0.0 ± 0.005 VDC.

3. Remove short at pin 5 of A8B and disconnect DVM.

e. OSCILLATOR 2 MODULATION AMOUNT ADJUSTMENT (Also, see Step j)

1. Depress /|/| FM VAR pushbutton and place all four slide controls full up.

2. Short pin 5 of A8B to ground and turn trim pot R100 fully clockwise for maximum resistance. (If blue or metal trim pots are used, turn R100 counterclockwise.)

3. Short junction of R99 and R100 to ground. Connect DVM to pin 6 of A14 and adjust trim pot R35 for an indication of 0.0 ± 0.010 VDC.

4. Remove shorts at pin 5 of A8B and junction of R99 and R100 and disconnect DVM. Perform phase modulation amount adjustment as directed in step i to obtain proper amount of phase modulation.

f. OSCILLATOR 1 RANGE ADJUSTMENT

1. Center trim pot R54 and front panel FINE TUNE and BEAT controls at far left of instrument panel.

2. Depress preset No. 8 and /|/| FM VAR pushbuttons. Place all four /|/| FM slide controls full down.

3. Monitor output, depress note A$_4$ and adjust trim pot R51 for an output frequency of 440 ± 1Hz.

g. OSCILLATOR 1 SCALE ADJUSTMENT

1. Adjust trim pot R54 for a normal center position.

h. OSCILLATOR 2 RANGE AND SCALE ADJUSTMENT

1. Center front panel FINE TUNE and BEAT controls.

2. Depress preset No. 8 and /|/| FM VAR pushbuttons. Place all four /|/| FM slide controls full down.

3. Depress KEYBOARD ⊓⊔⊓ WAVESHAPE LOWER/UPPER pushbuttons.

4. Monitor output, depress note Eb$_4$ (622.2 Hz), depress high point of RIBBON PITCH CONTROLLER and zero beat by adjusting ten turn trim pot R76 (Oscillator No. 2 RANGE).

5. Check oscillator scaling by observing BEAT RATE LED for a rate of 0Hz. Release RIBBON PITCH CONTROLLER and adjust R80 (scale trim pot for zero beat).

6. Repeat procedure until zero beat is observed on both center and upper positions.

i. PHASE MODULATION AMOUNT ADJUSTMENT (also, see step j)

1. Depress preset No. 1 and /|/| FM VAR pushbuttons. Place all four /|/| FM slide controls full up and trim pot R100 fully counterclockwise (clockwise if blue or metal trim pots).

2. Observe output at pin 6 of A19 using an oscilloscope triggered on the leading edge of the signal at pin 6 of A19.

3. Rotate trim pot R100 slowly clockwise (counterclockwise if blue or metal trim pots) noting

pulse width variation becomes narrower and narrower toward zero at various times. Adjust trim pot R100 so that the minimum pulse width is approximately [illegible] percent of the total duty cycle and disconnect oscilloscope.

j. ALTERNATE PHASE MODULATION AMOUNT ADJUSTMENT

1. Depress preset No. 8, upper ⎍⎍ waveshape, ⎍⎍ FM/PM VAR, LOCK, Key A4 (A440) and adjust RATE and AMOUNT to 10. Turn trim pot R100 fully clockwise (counterclockwise if blue or metal trim pots) and listen while turning counterclockwise until a smooth modulation is just present.

k. DRIVE LIMIT LEVEL ADJUSTMENT

1. Unplug connector P72 from board and monitor voltage at pin 1 of A24A.
2. Adjust trim pot R108 for an indication of -4.1 ± 0.050 VDC and connect P72.

l. SAWTOOTH LEVEL HIGH ADJUSTMENT

1. Unplug connector P72 from board and monitor voltage at pin 7 of A25B.
2. Adjust trim pot R114 for an indication of -5.1 ± VDC and connect P72.

m. SAWTOOTH LEVEL LOW ADJUSTMENT

1. Unplug connector P72 from board and monitor voltage at pin 1 of A25A.
2. Adjust trim pot R120 for an indication of -5.[illegible] ± 0.1 VDC and connect P72.

n. DECAY LOW SET ADJUSTMENT

1. Unplug connector P75 from board and monitor voltage at pin 7 of A26B.
2. Adjust trim pot R126 for an indication of -3.74 ± 0.020 VDC and connect P75.

o. DECAY MEDIUM SET ADJUSTMENT

1. Unplug connector P75 from board and monitor voltage at pin 1 of A26A.
2. Adjust trim pot R127 for an indication of -3.74 ± 0.020 VDC and connect P75.

p. DECAY HIGH SET ADJUSTMENT

1. Unplug connector P 75 from board and monitor voltage at pin 6 of A27.
2. Adjust trim pot R132 for an indication of -3.64 ± 0.020 VDC and connect P75.

q. PULSE WIDTH HIGH SET ADJUSTMENT

1. Unplug connectors P77 and P72 from board and monitor voltage at pin 1 of A28A.
2. Adjust trim pot R138 for an indication of -9.00 ± 0.050 VDC and connect P77 and P72.

r. PULSE WIDTH MEDIUM SET ADJUSTMENT

1. Unplug connectors P77 and P72 from board and monitor voltage at pin 1 of A29A.
2. Adjust trim pot R145 for an indication of -9.00 ± 0.050 VDC and connect P77 and P72.

s. PULSE WIDTH LOW SET ADJUSTMENT

1. Unplug connectors P77 and P72 from board and monitor voltage at pin 1 of A30A.
2. Adjust trim pot R152 for an indication of -9.00 ±0.050 VDC and connect P77 and P72.

t. ATTACK SET ADJUSTMENT

1. Unplug connector P78 from board and monitor waveform at pin of IC10A with an oscilloscope.
2. Adjust trim pot R165 so that the pulse at pin 1 just barely disappears (zero pulse width) and connect P78.

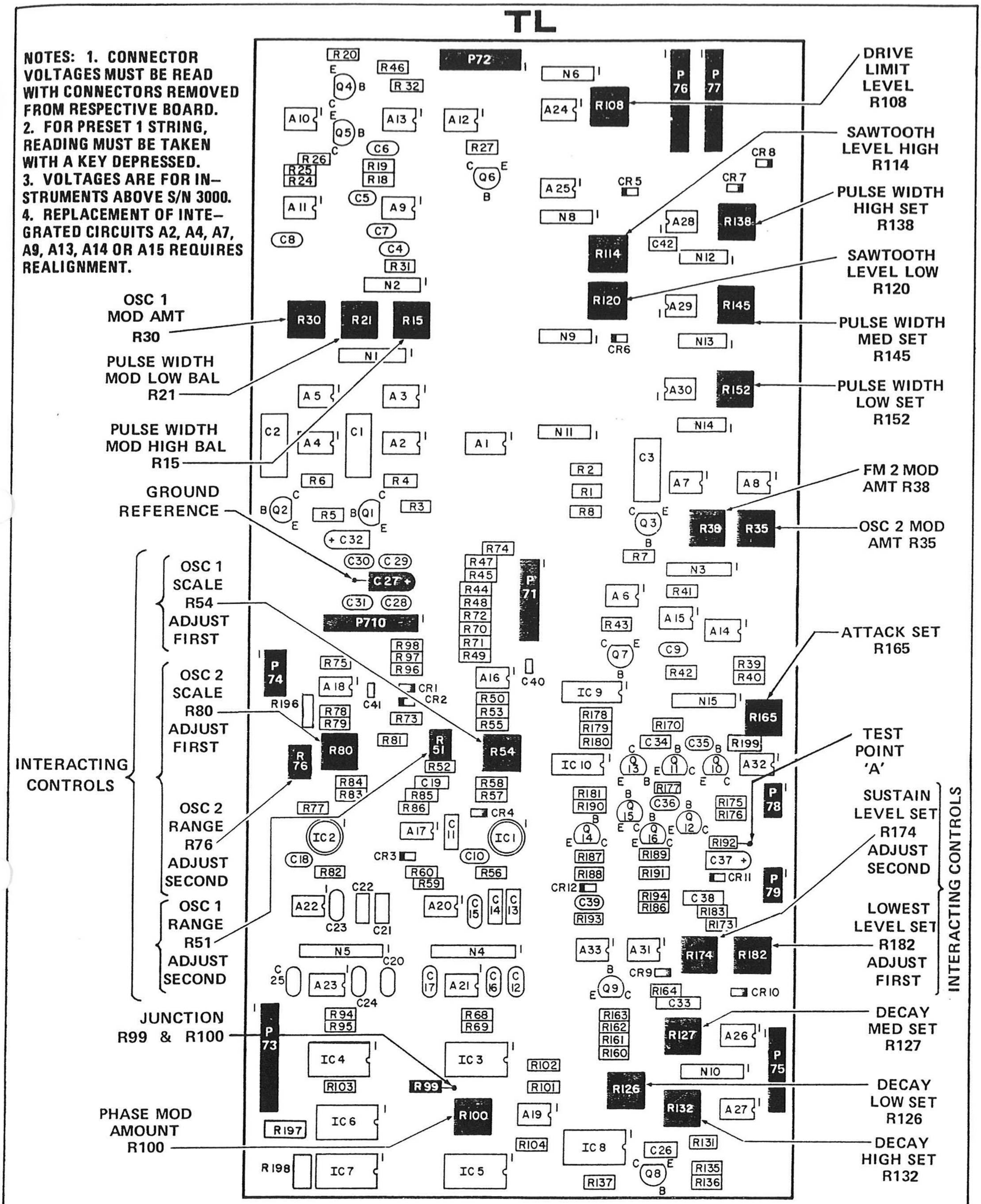
u. SUSTAIN LEVEL SET ADJUSTMENT

1. Unplug connector P78 from board and monitor a 20kHz square wave at pin 1 of P79 or test point "A" at R192 (Figure 4-2) with an oscilloscope.
2. Adjust trim pot R174 so that the peak-to-peak voltage of this waveform is 1.2 ± 0.050 volts and connect P78.

v. LOWEST LEVEL SET ADJUSTMENT

1. Unplug connector P78 from board and monitor voltage at pin 1 of P79 (test point "A" at R192).
2. Short pin 11 of IC10B or Q15 emitter to ground and adjust trim pot R182 for an indication of -3.60 ± 0.030 VDC. Remove short and connect P78.

NOTES: 1. CONNECTOR VOLTAGES MUST BE READ WITH CONNECTORS REMOVED FROM RESPECTIVE BOARD.
2. FOR PRESET 1 STRING, READING MUST BE TAKEN WITH A KEY DEPRESSED.
3. VOLTAGES ARE FOR INSTRUMENTS ABOVE S/N 3000.
4. REPLACEMENT OF INTEGRATED CIRCUITS A2, A4, A7, A9, A13, A14 OR A15 REQUIRES REALIGNMENT.


TL
OSC 1 MOD AMT R30
PULSE WIDTH MOD LOW BAL R21
PULSE WIDTH MOD HIGH BAL R15
GROUND REFERENCE
INTERACTING CONTROLS
OSC 1 SCALE R54 ADJUST FIRST
OSC 2 SCALE R80 ADJUST FIRST
OSC 2 RANGE R76 ADJUST SECOND
OSC 1 RANGE R51 ADJUST SECOND
JUNCTION R99 & R100
PHASE MOD AMOUNT R100
DRIVE LIMIT LEVEL R108
SAWTOOTH LEVEL HIGH R114
PULSE WIDTH HIGH SET R138
SAWTOOTH LEVEL LOW R120
PULSE WIDTH MED SET R145
PULSE WIDTH LOW SET R152
FM 2 MOD AMT R38
OSC 2 MOD AMT R35
ATTACK SET R165
TEST POINT 'A'
INTERACTING CONTROLS
SUSTAIN LEVEL SET R174 ADJUST SECOND
LOWEST LEVEL SET R182 ADJUST FIRST
DECAY MED SET R127
DECAY LOW SET R126
DECAY HIGH SET R132

Repeated on Inside Back Cover, Page 8-13, for Convenience While Performing Adjustments.

FIGURE 4-2 REFERENCE AND MODULATION OSCILLATOR WAVESHAPE AND KEYBOARD CONTROL PRINTED CIRCUIT BOARD ASSEMBLY

4.5 POLYMOOG KEYBOARD TUNING AND ADJUSTMENT

a. PULSE WIDTH MODULATION HIGH BALANCE ADJUSTMENT

1. Depress preset No. 12 and MODULATION VAR pushbuttons. Place both slide controls full up.

2. Short pin 5 of A3B to ground. Connect DVM to pin 6 of A9 and adjust trim pot R15 for an indication of 0.0 ± 0.02 VDC.

3. Remove short at pin 5 of A4B and disconnect DVM.

b. PULSE WIDTH MODULATION LOW BALANCE ADJUSTMENT

1. Depress preset No. 12 and MODULATION VAR pushbuttons. Place both slide controls full up.

2. Short pin 5 of A3B to ground. Connect DVM to pin 6 of A11 and adjust trim pot R21 for 0.0 ± 0.010 VDC.

3. Remove short at pin 5 of A3B and disconnect DVM.

c. OSCILLATOR 1 MODULATION AMOUNT ADJUSTMENT

1. Depress preset No. 2 and MODULATION VAR pushbuttons. Place both slide controls full up.

2. Short pin 5 of A5B to ground. Connect DVM to pin 6 of A13 and adjust trim pot R30 for an indication of 0.0 ± 0.005 VDC.

3. Remove short at pin 5 of A5B and disconnect DVM.

d. FM 2 MODULATION AMOUNT ADJUSTMENT

1. Depress preset No. 7 and MODULATION VAR pushbuttons. Place both slide controls full up.

2. Short pin 5 of A8B to ground. Connect DVM to pin 6 of A15 and adjust trim pot R38 for an indication of 0.0 ± 0.005 VDC.

3. Remove short at pin 5 of A8B and disconnect DVM.

e. OSCILLATOR 2 MODULATION AMOUNT ADJUSTMENT

1. Depress preset No. 7 and MODULATION VAR pushbuttons. Place both slide controls full up.

2. Short pin 5 of A8B to ground and turn trim pot R100 fully clockwise. (If blue or metal trim pots are used, turn R100 counterclockwise.)

3. Short junction of R99 and R100 to ground. Connect DVM to pin 6 of A14 and adjust trim pot R35 for an indication of 0.0 ± 0.010 VDC.

4. Remove shorts at pin 5 of A8B and junction of R99 and R100 and disconnect DVM. Perform phase modulation amount adjustment as directed in step i to obtain proper amount of phase modulation.

f. OSCILLATOR 1 RANGE ADJUSTMENT

1. Center trim pot R54 and front panel FINE TUNE and BEAT controls at far left of instrument panel.

2. Depress preset No. 9 and MODULATION VAR pushbuttons. Place two slide controls full down.

3. Monitor output, depress note A4 and adjust trim pot R51 for an output frequency of 440 ± 1Hz.

g. OSCILLATOR 1 SCALE ADJUSTMENT

1. Adjust trim pot R54 for a normal center position.

h. OSCILLATOR 2 RANGE AND SCALE ADJUSTMENT

1. Center front panel FINE TUNE and BEAT controls.

2. Depress preset No. 4 and MODULATION VAR pushbuttons. Place both slide controls full down.

3. Monitor output, depress note Eb$_4$, depress high point of RIBBON PITCH CONTROLLER and zero beat by adjusting ten turn trim pot R76.

4. Check oscillator scaling by observing BEAT RATE LED for a rate of 0Hz. Release RIBBON PITCH CONTROLLER and adjust R80 (scale trim pot) for zero beat.

5. Repeat procedure until zero beat is observed on both center and upper positions.

i. PHASE MODULATION AMOUNT ADJUSTMENT

1. Depress preset No. 14 and MODULATION VAR pushbuttons. Place both slide controls full up

and trim pot R100 fully counterclockwise (clockwise if blue or metal trim pots).

2. Observe output at pin 6 of A19 using an oscilloscope triggered on the leading edge of the signal at pin 6 of A19.

3. Rotate trim pot R100 slowly clockwise (counterclockwise if blue or metal trim pots) noting pulse width variation becomes narrower and narrower toward zero at various times. Adjust trim pot R100 so that minimum pulse width is approximately 10 percent of the total duty cycle and disconnect oscilloscope.

j. DRIVE LIMIT LEVEL ADJUSTMENT

1. Unplug connector P72 from board and monitor voltage at pin 1 of A24A.

2. Adjust trim pot R108 for an indication of -4.1 ± 0.050 VDC and connect P72.

k. SAWTOOTH LEVEL HIGH ADJUSTMENT

1. Unplug connector P72 from board and monitor voltage at pin 7 of A25B.

2. Adjust trim pot R114 for an indication of -5.1 ± 0.1 VDC and connect P72.

l. SAWTOOTH LEVEL LOW ADJUSTMENT

1. Unplug connector P72 from board and monitor voltage at pin 1 of A25A.

2. Adjust trim pot R120 for an indication of -5.1 ± 0.1 VDC and connect P72.

m. DECAY LOW SET ADJUSTMENT

1. Unplug connector P75 from board and monitor voltage at pin 7 of A26B.

2. Adjust trim pot R126 for an indication of -3.74 ± 0.020 VDC and connect P75.

n. DECAY MEDIUM SET ADJUSTMENT

1. Unplug connector P75 from board and monitor voltage at pin 1 of A26A.

2. Adjust trim pot R127 for an indication of -3.74 ± 0.020 VDC and connect P75.

o. DECAY HIGH SET ADJUSTMENT

1. Unplug connector P75 from board and monitor voltage at pin 6 of A27.

2. Adjust trim pot R132 for an indication of -3.64 ± 0.020 VDC and connect P75.

p. PULSE WIDTH HIGH SET ADJUSTMENT

1. Unplug connectors P77 and P72 from board and monitor voltage at pin 1 of A28A.

2. Adjust trim pot R138 for an indication of -9.00 ± 0.050 VDC and connect P77 and P72.

q. PULSE WIDTH MEDIUM SET ADJUSTMENT

1. Unplug connectors P77 and P72 from board and monitor voltage at pin 1 of A29A.

2. Adjust trim pot R145 for an indication of -9.00 ± 0.050 VDC and connect P77 and P72.

r. PULSE WIDTH LOW SET ADJUSTMENT

1. Unplug connectors P77 and P72 from board and monitor voltage at pin 1 of A30A.

2. Adjust trim pot R152 for an indication of -9.00 ± 0.050 VDC and connect P77 and P72.

s. ATTACK SET ADJUSTMENT

1. Unplug connector P78 from board and monitor waveform at pin of IC10A with an oscilloscope.

2. Adjust trim pot R165 so that the pulse at pin 1 just barely disappears (zero pulse width) and connect P78.

t. SUSTAIN LEVEL SET ADJUSTMENT

1. Unplug connector P78 from board and monitor a 20kHz square wave at pin 1 of P79 or test point "A" at R192 (Figure 4-2) with an oscilloscope.

2. Adjust trim pot R174 so that the peak-to-peak voltage of this waveform is 1.2 ± 0.050 volts and connect P78.

u. LOWEST LEVEL SET ADJUSTMENT

1. Unplug connector P78 from board and monitor voltage at pin 1 of P79 (test point "A" at R192).

2. Short pin 11 of IC10B or Q15 emitter to ground and adjust trim pot R182 for an indication of -3.60 ± 0.030 VDC. Remove short and connect P78.

4.6 REMOVAL

a. If it is necessary to remove a component, remove four screws located at the center and to the right of the board.

b. Raise board to gain bottom access noting it is hinged at the left side.

4.7 TROUBLESHOOTING

Troubleshoot the TL board using Table 4-1, the circuit description (paragraph 4.1), part location and schematic diagrams (Refer to Volume II). Note that voltage levels and waveforms displayed on the schematic diagram are not absolute values as readings may vary between units. Once the problem is localized, check the suspected part by direct substitution if possible. Otherwise use a digital voltmeter or oscilloscope to determine the malfunctioning part.

TABLE 4-1

POLYMOOG AND POLYMOOG KEYBOARD TL BOARD 7 TROUBLESHOOTING

PROBLEM	PROBABLE DEFECTIVE COMPONENT
No pulse width modulation UPPER AMT	A10A, Q4, A9*, N2, trim pot R15 not adjusted properly.
No pulse width modulation LOWER AMT	A10B, Q5, A11*, trim pot R21 not adjusted properly.
No pulse width modulation UPPER or LOWER AMT	A3, A2*, A1A, Q1, N1
No FM1 modulation	A12B, Q6, A13*, A5, A4*, A1B, Q2, trim pot R30 not adjusted properly.
No FM2 modulation but phase modulation	A15*, trim pot R38 not adjusted properly.
No phase modulation but have FM2 modulation	A14*, trim pot R35 not adjusted properly, N3
No FM2 modulation or phase modulation	A6B, Q7, A8, A7*, A6A, Q3
Reference oscillator No. 1 dead	A16, IC1, A17B, A20, A21, IC3, trim pots R51 and R54 not adjusted properly, N4
Reference oscillator No. 2 dead	A18, IC2, A17A, A22, A23, IC4, trim pots R76 and R80 not adjusted properly, N5
Reference oscillator No. 1 and 2 dead	A17
Phase modulation causes pitch glitching	Trim pot R100 adjusted too high or trim pot R35 misadjusted.
Reference oscillator No. 1 operates properly but high frequency oscillator on divider board does not synchronize	IC6
Reference oscillator No. 2 operates properly but does not sychronize when instrument is in FREE mode	IC5, IC4, IC7

* Replacement requires alignment.

TABLE 4-1
POLYMOOG AND POLYMOOG KEYBOARD TL BOARD 7 TROUBLESHOOTING (Continued)

PROBLEM	PROBABLE DEFECTIVE COMPONENT
Instrument operates in FREE mode but does not in LOCK mode	A19, IC3, IC4, IC5
Drive level limit will not adjust or is wrong value	A24, trim pot R108, N6
Sawtooth level does not operate properly	A25B, CR5, N8, trim pot R114 not adjusted properly
Sawtooth level low does not operate properly or will not adjust	A25A, CR6, N9, trim pot R120
Decay low control does not operate properly or will not trim	A26B, trim pot R126, N10
Decay medium and decay high will not adjust properly	A26A, A27, N10, trim pots R127 and R132
Decay medium operates properly but decay high does not	A27, trim pot R132 not adjusted properly, N10
Reference oscillators operate properly but front panel BEAT rate LED does not	IC8, Q8, L1 (front panel)
Pulse width high cannot be trimmed or does not operate properly	A28, N12, trim pot R138, N11
Pulse width medium does not operate properly or cannot be trimmed	A29, N13, trim pot R145, N11
Pulse width low does not operate properly or cannot be trimmed	A30, N14, trim pot R152, N11
ATTACK time control does not operate properly or cannot be trimmed	IC9, IC10, Q13, A32A, Q10, Q11, N15, trim pot R165
DYNAMIC control does not operate properly	A31A, Q14, trim pot R182 not adjusted properly
SUSTAIN level does not operate properly or will not trim	A32B, Q12, IC9, IC10, Q10, Q11, Q13, trim pot R174
Noise or hash on highest or lowest level busses	A31, Q9, CR9, CR10, A33, CR12, CR11, Q15, Q16
Oscillator frequency increases as unit warms up	IC1, IC2
	* Replacement requires alignment.

TABLE 4-2

REFERENCE AND MODULATION OSCILLATOR WAVESHAPE AND KEYBOARD CONTROL PRINTED CIRCUIT TL BOARD 7 ASSEMBLY REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-040177-002	Printed Circuit Board Assembly consisting of:	
A1,A3,A5,A6, A8,A10,A12, A24,A25,A26, A28,A29,A30, A31,A32	991-041084-001	Integrated Circuit, Dual Operational Amplifier, LM358N	15
A2,A4,A7,A9, A11,A13,A14, A15	991-041089-004	Integrated Circuit, LM3080AN	8
A16,A17,A18	991-041102-001	Integrated Circuit, Dual Operational Amplifier, MC1458CP-1	3
A19,A27,A33	991-041101-001	Integrated Circuit, Operational Amplifier, 741	3
A20 thru A23	991-041083-001	Integrated Circuit, 3130	4
1 thru C3	946-040229-105	Capacitor, Polyester, 1.0uf	3
C4,C5,C10,C16, C18,C24,C28 thru C31,C36, C39,C40,C41, C42	947-040200-103	Capacitor, Disc, 0.01uf	15
C6 thru C9	947-042020-501	Capacitor, Disc, 500pf	4
C11,C19,C26, C38	946-040229-104	Capacitor, Polyester, 0.1uf	4
C12,C20	947-042020-120	Capacitor, Disc, 12pf	2
C13,C21	946-042021-511	Capacitor, Polystyrene, 510pf	2
C15,C23	947-042020-470	Capacitor, Disc, 47pf	2
C17,C25	947-042020-390	Capacitor, Disc, 39pf	2
C27,C32,C37	946-040231-002	Capacitor, Tantalum, 10uf, 25V	3
C33	946-040231-003	Capacitor, Tantalum, 2.7uf, ± 10%, 20V	1
C34	946-040229-224	Capacitor, Polyester, 0.22uf	1
C35	947-042020-102	Capacitor, Disc, 0.001uf	1
CR1 thru CR12	919-041075-001	Diode, 1N4148, Alt. 1N914	12
IC1,IC2	991-041073-001	Integrated Circuit, 726	2
IC3,IC4	991-041086-001	Integrated Circuit, CMOS, CD4007AE	2
IC5,IC8	991-041088-001	Integrated Circuit, CMOS, CD4011AE	2
IC6,IC7	991-041091-001	Integrated Circuit, CMOS, CD4046A	2
IC9	991-041095-001	Integrated Circuit, SN7413	1
IC10	991-041096-001	Integrated Circuit, SN7426	1
N1	949-040241-002	Resistor Network, Modulation Oscillator No. 6 (R9 thru R12, R28,R29)*	1
N2	949-040240-002	Resistor Network, Modulation Oscillator No. 5 (R16, R17, R22, R23)*	1
		* See Schematic Diagram for Resistor Values	

TABLE 4-2

REFERENCE AND MODULATION OSCILLATOR WAVESHAPE AND KEYBOARD CONTROL PRINTED CIRCUIT TL BOARD 7 ASSEMBLY REPLACEMENT PARTS LIST (Continued)

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
N3	949-040242-002	Resistor Network, FM Oscillator (R13, R14, R33, R34, R36, R37)*	1
N4,N5	949-040243-001	Resistor Network, Reference Oscillator No. 1 (R61 thru R67), No. 2 (R87 thru R93)*	2
N6	949-040236-001	Resistor Network, Modulation Oscillator No. 1 (R109 thru R113)*.	1
N8,N9	949-040238-001	Resistor Network, Modulation Oscillator No. 3 (R115 thru R119, R121 thru R125)*	2
N10	949-040245-001	Resistor Network, Keyboard Decay (R126, R128, R129, R130, R133, R134)*	1
N11	949-040239-001	Resistor Network, Modulation Oscillator No. 4 (R144, R151, R158, R159)*	1
N12,N13,N14	949-040690-001	Resistor Network, Pulse Width Control (R139 thru R143, R146 thru R150, R153 thru R157)*	3
N15	949-040244-001	Resistor Network, Keyboard Attack (R166 thru R169, R171, R172)*	1
P71,P75	910-040301-007	Header, Printed Circuit, 7 Pin, (0.15 Centers), AMP640057-7	2
P72	910-040301-006	Header, Printed Circuit, 6 Pin, (0.15 Centers), AMP640057-6	1
P73	910-040301-009	Header, Printed Circuit, 9 Pin, (0.15 Centers), AMP640057-9	1
P74	910-040301-004	Header, Printed Circuit, 4 Pin, (0.15 Centers), AMP640057-4	1
P76,P77	910-040301-008	Header, Printed Circuit, 8 Pin, (0.15 Centers), AMP640057-8	2
P78,P79	910-040301-003	Header, Printed Circuit, 3 Pin, (0.15 Centers), AMP640057-3	2
P710	910-040306-007	Header, Printed Circuit, 7 Pin, Keyed, (0.15 Centers), AMP640245-1	1
Q1 thru Q12, Q14,Q15,Q16,	919-041052-001	Transistor, PNP, 2N3906	15
Q13	991-041053-001	Transistor, Darlington, D16P1	1
R1,R55	852-312473-001	Resistor, 47K Ohm, ± 5%, 1/4W	2
R2,R3,R5,R7, R20,R26,R27, R43,R69,R95, R175	852-312103-001	Resistor, 10K Ohm, ± 5%, 1/4W	11
R4,R6,R8,R74	852-312515-001	Resistor, 5.1 Megohm, ± 5%, 1/4W	4
R15,R21,R30, R35,R38,R132, R165	925-040266-002	Resistor, Trim Pot, 100K Ohm	7
R18,R24,R31, R41	852-312510-001	Resistor, 51 Ohm, ± 5%, 1/4W	4
R19,R25,R32, R164	852-312105-001	Resistor, 1 Megohm, ± 5%, 1/4W	4
R39	852-312202-001	Resistor, 2K Ohm, ± 5%, 1/4W	1
R40,R183	852-312333-001	Resistor, 33K Ohm, ± 5%, 1/4W	2
R42,R161, R186	852-312153-001	Resistor, 15K Ohm, ± 5%, 1/4W	3
		* See Schematic Diagram for Resistor Values	

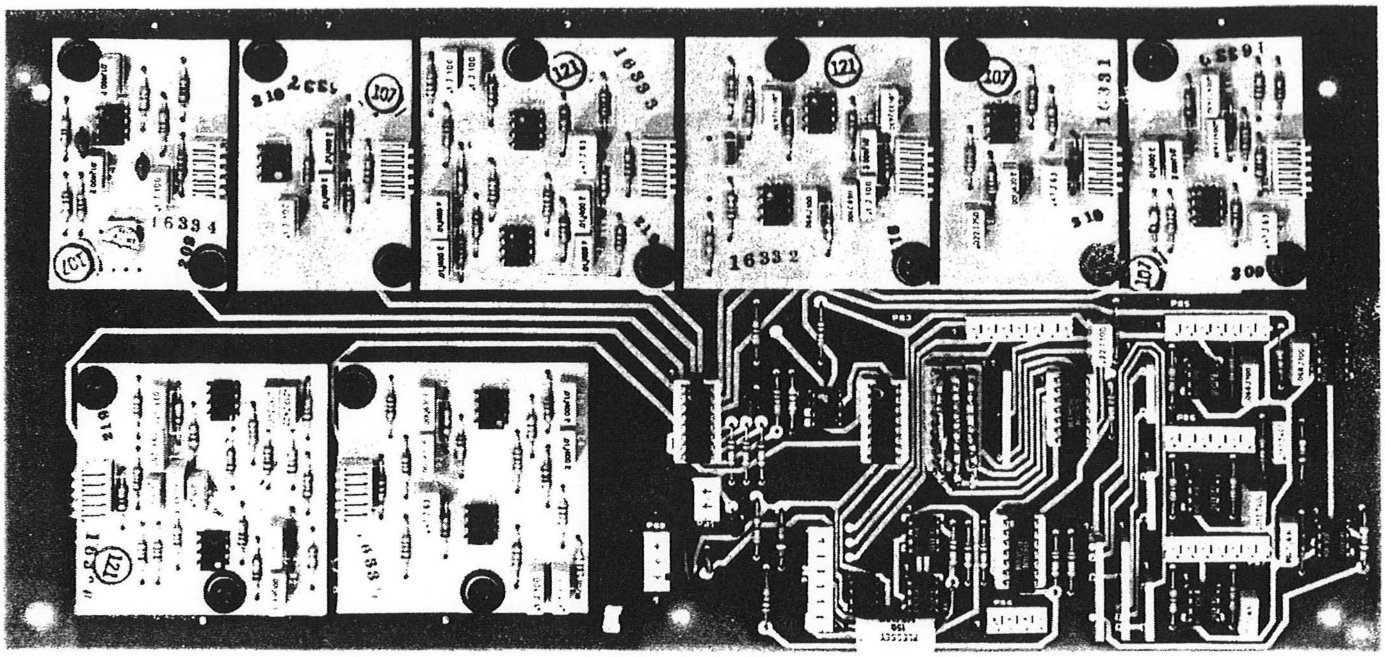
TABLE 4-2

REFERENCE AND MODULATION OSCILLATOR WAVESHAPE AND KEYBOARD CONTROL PRINTED CIRCUIT TL BOARD 7 ASSEMBLY REPLACEMENT PARTS LIST (Continued)

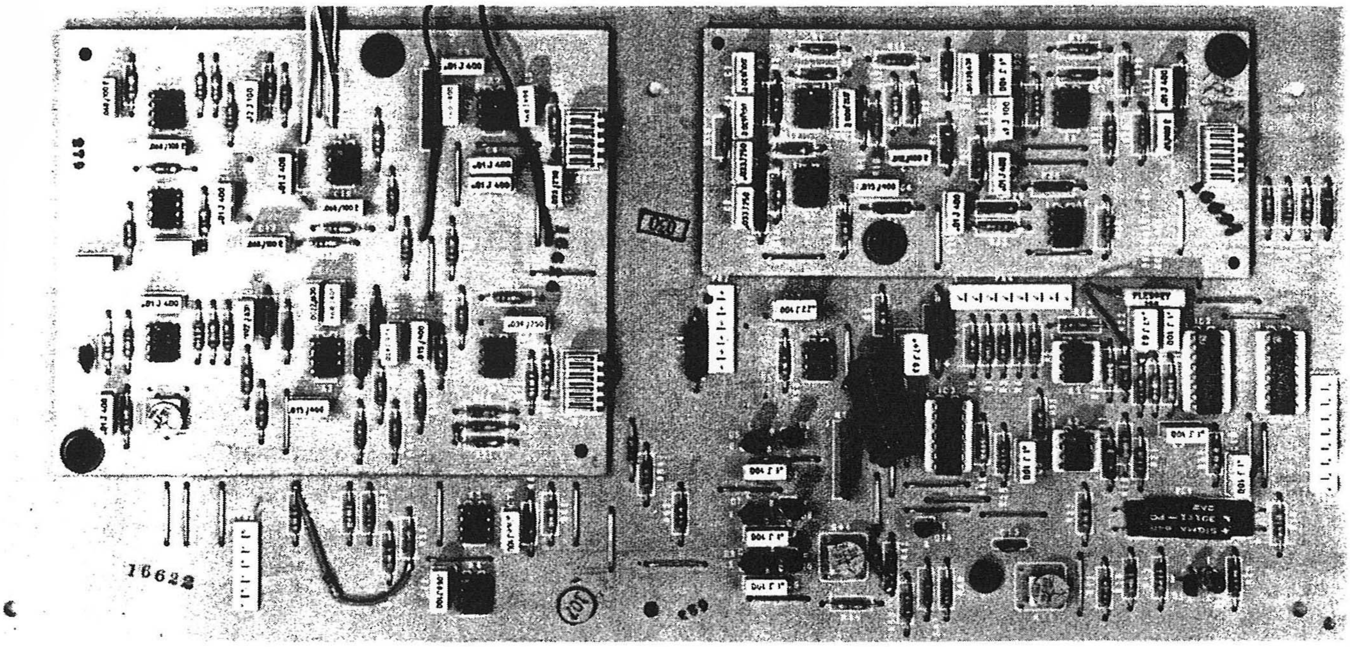
INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
R44,R46,R59, R71,R85,R180, R181,R189	852-312102-001	Resistor, 1K Ohm, ± 5%, 1/4W	8
R45,R101, R103,R104, R191	852-312104-001	Resistor, 100K Ohm, ± 5%, 1/4W	5
R47,R70	852-312334-001	Resistor, 330K Ohm, ± 5%, 1/4W	2
R48,R49,R50, R57,R72,R75, R78,R83	853-421002-031	Resistor, 10K Ohm, ± 1%, 1/4W	8
R51,R76	925-040378-001	Resistor, Trim Pot, 20 Turn, 10K Ohm.	2
R52,R77	853-424753-031	Resistor, 475K Ohm, ± 1%, 1/4W.	2
R53,R79	853-429530-031	Resistor, 953 Ohm, ± 1%, 1/4W	2
R54,R80	925-040266-004	Resistor, Trim Pot, 100 Ohm	2
R55,R56,R81, R82,R195,R196	853-422003-031	Resistor, 200K Ohm, ± 1%, 1/4W.	6
R58,R84	853-422004-031	Resistor, 2 Megohm, ± 1%, 1/4W	2
R60,R86	852-312205-001	Resistor, 2 Megohm, ± 5%, 1/4W	2
R68,R94	852-312101-001	Resistor, 100 Ohm, ± 5%, 1/4W	2
R73	852-312155-001	Resistor, 1.5 Megohm, ± 5%, 1/4W	1
R96	852-312104-001	Resistor, Selected, 100K to 160K Ohm, ± 5%, 1/4W	1
R97	853-421872-031	Resistor, 18.7K Ohm, ± 1%, 1/4W	1
R98	852-312225-001	Resistor, 2.2 Megohm, ± 5%, 1/4W	1
R99	852-312512-001	Resistor, 5.1K Ohm, ± 5%, 1/4W	1
R100,R108, R114,R120, R126,R127, R138,R145, R152,R174, R182	925-040266-001	Resistor, Trim Pot, 10K Ohm	11
R102	852-312474-001	Resistor, 470K Ohm, ± 5%, 1/4W.	1
R131	852-312564-001	Resistor, 560K Ohm, ± 5%, 1/4W	1
R135,R136	852-312223-001	Resistor, 22K Ohm, ± 5%, 1/4W	2
R137,R178	852-312181-001	Resistor, 180 Ohm, ± 5%, 1/4W	2
R160	852-312272-001	Resistor, 2.7K Ohm, ± 5%, 1/4W	1
R162	852-312274-001	Resistor, 270K Ohm, ± 5%, 1/4W.	1
R163	852-312221-001	Resistor, 220 Ohm, ± 5%, 1/4W	1
R170	852-312121-001	Resistor, 120 Ohm, ± 5%, 1/4W	1
R173	852-312303-001	Resistor, 30K Ohm, ± 5%, 1/4W	1
R176,R194, R197,R198	852-312472-001	Resistor, 4.7K Ohm, ± 5%, 1/4W	4
R177,R190	852-312471-001	Resistor, 470 Ohm, ± 5%, 1/4W	2

TABLE 4-2
REFERENCE AND MODULATION OSCILLATOR WAVESHAPE AND KEYBOARD CONTROL PRINTED CIRCUIT TL BOARD 7 ASSEMBLY REPLACEMENT PARTS LIST (Continued)

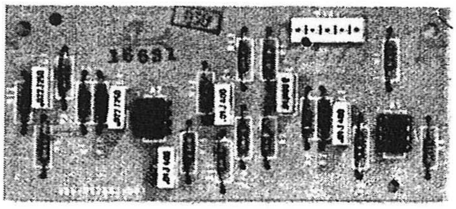
INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
R179	852-312470-001	Resistor, 47 Ohm, ±5%, 1/4W	1
R187	852-312432-001	Resistor, 4.3K Ohm, ±5%, 1/4W	1
R188	852-312621-001	Resistor, 620 Ohm, ±5%, 1/4W	1
R192	852-312180-001	Resistor, 18 Ohm, ±5%, 1/4W	1
R193	852-312475-001	Resistor, 4.7 Megohm, ±5%, 1/4W	1
R199	852-312273-001	Resistor, 27K Ohm, ±5%, 1/4W	1
	906-042012-008	Socket, Integrated Circuit, DIP, 8 Pin, AMP583640-1	12
	906-040377-001	Socket, Integrated Circuit, TO5, AUGAT 8058-24G1	2
	906-040307-007	Socket, Integrated Circuit, SIL, 7 Pin, AMP1-583773-4	8
	906-040307-008	Socket, Integrated Circuit, SIL, 8 Pin, AMP1-583773-5	4



POLYMOOG FIXED AND VARIABLE RESONANT FILTERS BOARD 8



POLYMOOG KEYBOARD AUDIO CIRCUIT BOARD 8



POLYMOOG KEYBOARD
VOX HUMANA BOARD 14

SECTION 5
BOARDS 8 AND 14
FIXED AND VARIABLE RESONANT FILTERS AND VOX HUMANA
TC

5.1 CIRCUIT DESCRIPTION – POLYMOOG

The fixed and variable resonant filters printed circuit board No. 8 (TC) contains three basic circuit functions: (1) summing of mother board outputs for the DIRECT output; (2) MODE (preset) filtering for eight basic modes; and (3) a three band RESONANT filter where each filter has variable gain, cutoff and Q (resonance), low, band and high pass modes. (Refer to Volume II for schematic).

The audio signal outputs of the low, medium and high mother boards are applied directly to OCTAVE BAL controls R65 thru R67 on the front panel. The wipers of these three controls are connected to the OUTLW, OUTMW, and OUTHW lines which enter the TC board on pins 1 thru 3 of P83. These three audio signals are summed together by an inverting amplifier comprised of A1A and R5 thru R8, providing a composite audio signal applied to the top of the DIRECT gain slide control R3 in the MASTER GAIN CONTROLS section of the front via pin 6 of P82.

In addition, these mother board audio signals are applied to the low-high select gates in IC1 via R11 thru R13. The audio signals from the mother boards are biased at +4.85 VDC, the audio reference potential. The +15 VDC signal on the C (control) lines of IC1 opens the respective gate, so that, for example, if the upper keyboard section is selected, the SREH line is at +15 VDC and gates 1 and 2 are open, applying signals from the medium and high mother boards to buffer amplifiers A2A and A2B, respectively. These selected buffered mother board signals drive the preset gain adjust resistor networks N2 thru N4 and also resonator drive amplifier A3B via summing resistors R18 thru R20, gate 4 and IC1, which is held on at all times.

The resistors in networks N2 thru N4 are used to compensate for variations in signal levels coming from the mother boards when selecting different preset modes. Three corresponding resistors (one from each resistor pack) are applied to one of the eight inputs of the mode selector gates contained in IC2. IC2 is a CMOS analog multiplexer switch which routes one of the eight inputs to the common output, pin 3. The SPB1, 2 and 3 control lines applied to pins 11, 10 and 9 of IC2 contain a binary coded representation of the active preset mode and determine which one of the eight applied input signals is routed to the output on pin 3. The output of IC2 is connected to drive amplifier A4 which drives eight master preset filters in parallel. The eight master preset filter outputs are applied to a second 8 to 2 analog selector switch, IC3, whose output on pin 3 is connected via pin 4 of P82 to front panel MODE gain control R1 (in the MASTER GAIN CONTROLS section). This output selector is driven by the same SPB lines as is gain set selector, IC2.

Supply rails of +12.5 and -2.5 VDC for the selector switches in IC2 and IC3 are derived from networks comprised of R46 thru R48 and Q1 and R49, R50, R106 and Q2, respectively. Operation of the analog switches at these voltages allows for maximum signal voltage headroom, for if the voltage applied to one of the analog switch inputs should exceed the supply rails, it will leak through the selector gates even though the gate is turned off.

Three state-variable filters comprised of amplifiers A5 thru A9 are driven by buffer amplifier A3B which is driven by three drive amplifiers A2A, A2B and A3A via summing resistors R18 thru R20.

The three filters (RESONATORS) cover frequency ranges of 60 to 300 Hz, 300 to 1500 Hz, and 1500 to 7500 Hz. The drive signal from A3B is applied to three front panel GAIN slide controls R58, R68 and R80. The reference or ground side of these GAIN slide controls is connected to the audio reference rail (V_{ch} = +4.85 VDC) via pin 3 of P87. These GAIN slide controls apply a variable input to the state-variable filters. The 60 to 300 Hz resonator is comprised of A5A, A5B, A6A and associated components.

The input drive signal is applied to combining amplifier A5A driving an integrator comprised of the A element of 10K ohm dual linear pot R60, R56, C2 and A5B in turn driving a second integrator comprised of the B element of 10K ohm dual linear pot R60, R57, C3 and A6A. Feedback is applied to the negative input of the combining amplifier via R51 and to the positive input of the combining amplifier via R54 from the first integrator. The high pass output is taken from output pin 1 of combining amplifier A5A, the band pass output is taken from the output of the first integrator, pin 7 of A5B and the low pass output is taken from pin 1 of A6A. The cutoff frequency is varied by 10K ohm dual linear pot R60. The Q or emphasis is varied by attenuating feedback applied to the positive input of combining amplifier A5A via R59 (a 10K ohm linear pot on the front panel labeled EMPH). The high and low pass ports have 12dB/0 CT cutoff slopes. The band pass has 6dB cutoff slopes.

Frequency scaling for the three filter sections is accomplished by varying the integrator capacitances. Corresponding outputs from each of the three filter sections are summed together in resistor networks N8 and N9 and applied to the filter mode selector switches contained in IC4, a CMOS analog switch. The E (equalization) mode derived via summing resistors R91 thru R93 and amplifier A9B is currently not used on the Polymoog. Either analog switch 1, 2 or 4 is turned on via a +15 VDC control signal from mode selector switch SW1 on the front panel. The selected gate feeds output resonator current to gain recovery amplifier A1B driving the front panel RES master gain control R2 via pin 5 of P82.

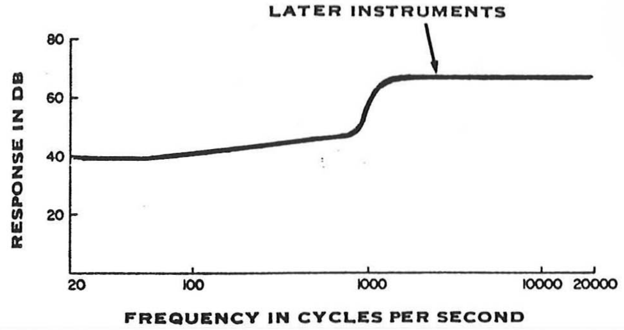
Eight master preset (MODE) filters are contained on eight separate boards which plug into the top center board. (Volume II.) Figure 5-1 illustrates the frequency response of these eight filters. String filter board No. 1 contains a high pass section comprised of C1 and R1 with a corner frequency of 80 Hz and is buffered by A1A driving a shelving filter comprised of R2, R3 and C2 with a corner frequency of 4.7 kHz. The shelving filter output drives amplifier A1B whose output is capacitively coupled to the final output on pin 6. Piano filter board No. 2 is comprised of two low pass sections with interstage buffering by A1B with a corner frequency for each filter of 60 Hz, followed by a gain of two amplifiers comprised of A1A, R2 and R3 driving a high pass section comprised of C3 and R5 with a corner frequency of 300 Hz. The high pass section output drives the sharp cutoff two pole filter with a corner frequency of 1 kHz comprised of A2A, A2B, R7, C5, R6 and C4. The output of the sharp cutoff filter on pin 7 of A2B drives a single low pass section with a corner frequency of 3.4 kHz. This low pass section is coupled to the output via C7. Organ filter board No. 3 is comprised of three band pass filter sections comprised of A1A, A2A, A2B and associated components. These three band pass filters are summed by A1B and are capacitively coupled to the output via C3. Harpsichord filter board No. 4 is comprised of a two stage shelving filter with a corner frequency of 3.0 kHz. Trim pot R4 allows for varying shelf height. This two stage filter drives another high pass section comprised of C3 and R6 with a corner frequency of 660 Hz and feeds drive amplifier A1B coupled to the output via C4. Funk filter board No. 5 is comprised of three band pass sections summed via A1B and capacitively coupled to the output via C3. Clavinet filter board No. 6 is also comprised of three band pass filters summed via A1B and capacitively coupled via C5 to the output. An additional direct feed occurs via the high pass section comprised of C1 and R1 and this coupling causes a notch at approximately 3.0 kHz. Vibes filter board No. 7 consists of a single band pass filter capacitively coupled to the output via C3. Brass filter board No. 8 is comprised of a single band pass filter capacitively coupled to the output via C3.

5.2 GENERAL SERVICING

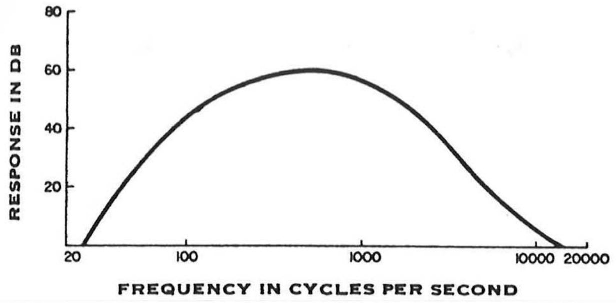
The TC board contains three main audio paths: DIRECT, MODE and RESONATOR. An audio signal through these paths may be traced in a straight forward manner using an oscilloscope. Selection of a preset followed by depression of a note should cause an audio signal to appear from the appropriate mother board on pins 1 thru 3 of P83. The direct signal path consists of single amplifier A1A. The MODE filter signal is traced sequentially through IC1, A2A, A2B, A3A, gain compensation resistor networks N2 thru N4, input selector IC2, drive amplifier A4, output of the preset filters on pin 6 of the individual filter board connectors, output selector IC3 and finally to the voltage output on pin 3 of IC3.

NOTE

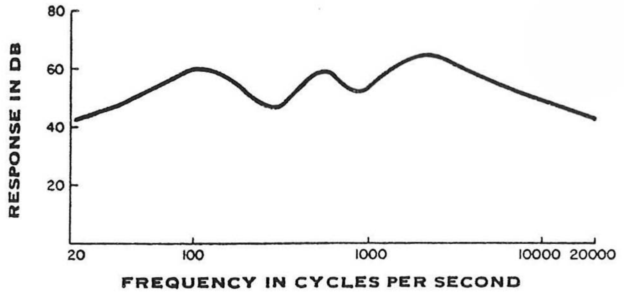
The power supply output voltages must be checked and adjusted if necessary (refer to Table 8-1) prior to all troubleshooting and alignment procedures and after replacement of all malfunctioning parts.



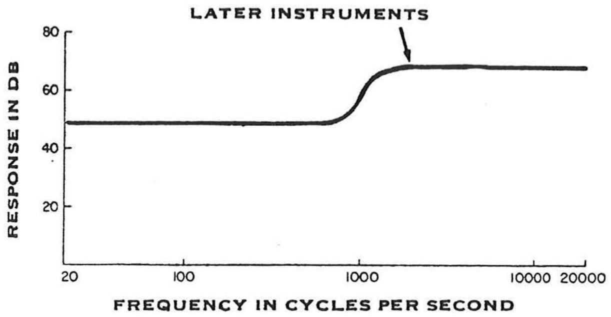
String Filter Board No. 1



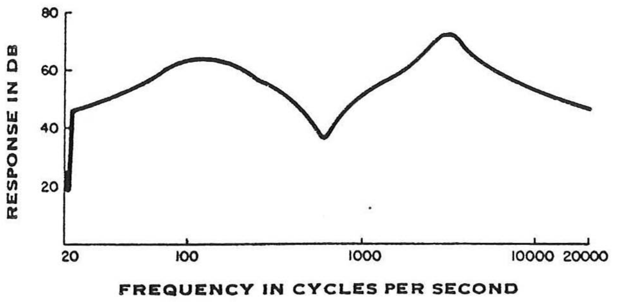
Piano Filter Board No. 2



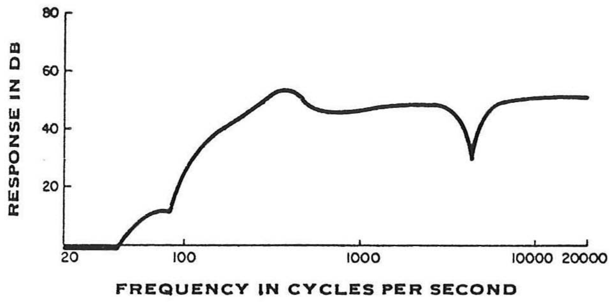
Organ Filter Board No. 3



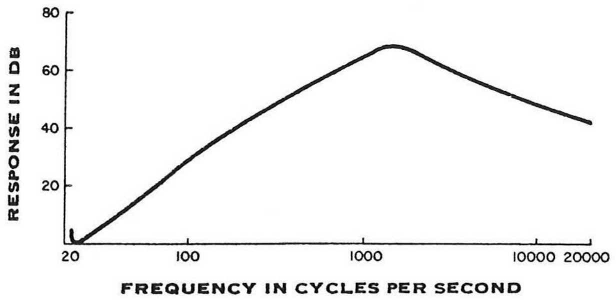
Harpsichord Filter Board No. 4



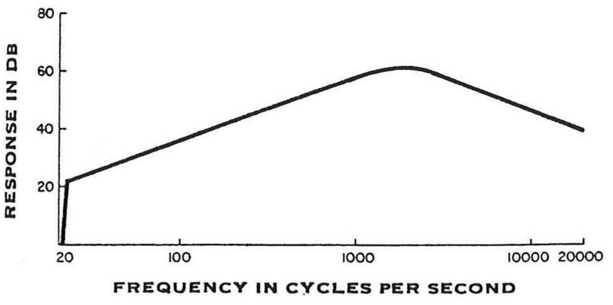
Funk Filter Board No. 5



Clavinet Filter Board No. 6



Vibes Filter Board No. 7



Brass Filter Board No. 8

FIGURE 5-1 POLYMOOG FREQUENCY RESPONSE OF FILTER BOARDS NO. 1 THRU 8 (TC BOARD 8)

5.3 ALIGNMENT

The only adjustment for the TC board is setting trim pot R4 on harpsichord filter board No. 4 to its mechanical center position or to desired position while listening to the harpsichord mode output.

5.4 REMOVAL

The TC board is hinged at the right edge and may be lifted up for bottom access by removing four screws at the left and center of the board.

5.5 TROUBLESHOOTING

Troubleshoot the TC board using Table 5-1, circuit description (paragraph 5.1), general servicing (paragraph 1.16), and parts location and schematic diagrams (Volume II). Note that voltage levels and waveforms displayed on the schematic diagram are not absolute values as readings may vary between units. Once the problem is localized, check the suspected part by direct substitution if possible. Otherwise use a voltmeter or oscilloscope to determine the malfunctioning part.

TABLE 5-1
POLYMOOG TC BOARD 8 TROUBLESHOOTING

PROBLEM	PROBABLE DEFECTIVE COMPONENT
No DIRECT slide control R3 response	A1A, N1, mother board outputs
No MODE slide control R1 response	IC1, A2B, A2A, N1 thru N4, IC2, A4, Q2, IC3, Q1, master preset filter boards No. 1 thru 8, mother board outputs
No LOW, MED or HIGH resonator outputs or no RES slide control R2 response	IC4, A1B, IC1, A3A, A3B, C1, A2A, A2B
No low frequency (60 to 300 Hz) resonator output or no LOW GAIN, LOW EMPH or LOW CF slide control (R58 thru R60) response	A5A, A5B, A6A, N5, N8, N9, IC4, SW1
No medium frequency (300 to 1500 Hz) resonator output or no MED GAIN, MED EMPH or MED CF slide control (R68 thru R70) response	A7A, A7B, A6B, A9B, N6, N8, N9, IC4, SW1
No high frequency (1500 to 7500 Hz) resonator output or no HIGH GAIN, HIGH EMPH or HIGH CF slide control (R80 thru R82) response	A8A, A8B, A9A, N7, N8, N9, IC4, SW1

TABLE 5-2

POLYMOOG FIXED AND VARIABLE RESONANT FILTERS PRINTED CIRCUIT TC BOARD 8 ASSEMBLY REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-040181-002	Fixed and Variable Resonant Filters Printed Circuit Board Assembly consisting of:	
	996-040352-001	String Filter Board No. 1, (Version 1 and 2, Tables 5-3, 5-4)	1
	996-040356-001	Piano Filter Board No. 2, (See Table 5-5)	1
	996-040360-001	Organ Filter Board No. 3 (See Table 5-6)	1
	996-040364-001	Harpsichord Filter Board No. 4 (See Table 5-7)	1
	996-040360-001	Funk Filter Board No. 5 (See Table 5-8)	1
	996-040370-001	Clavinet Filter Board No. 6 (See Table 5-9)	1
	996-040374-001	Vibes Filter Board No. 7 (See Table 5-10)	1
	996-040374-001	Brass Filter Board No. 8 (Version 1, See Table 5-11)	1
	996-040653-001	Brass Filter Board No. 8 (Version 2, See Table 5-12)	1
A1,A2,A3, A5 thru A9	991-041102-001	Integrated Circuit, Dual Operational Amplifier, MC1458CP-1	8
A4	991-041101-001	Integrated Circuit, Operational Amplifier, 741	1
C1	946-040229-224	Capacitor, Polyester, 0.22uf	1
C2,C3	946-040229-683	Capacitor, Polyester, 0.068uf	2
C4,C5	946-040229-123	Capacitor, Polyester, 0.012uf	2
C6,C7	946-040229-272	Capacitor, Polyester, 0.0027uf	2
C11	947-040194-223	Capacitor, Disc, 0.022uf	1
C12	947-040200-103	Capacitor, Disc, 0.01uf	1
IC1,IC4	991-041087-001	Integrated Circuit, CMOS, CD4016AE	2
IC2,IC3	991-041090-001	Integrated Circuit, CD4051AE	2
N1	949-040248-001	Resistor Network, Variable Resonator Input Mode (R5 thru R8, R11 thru R14)*	1
N2	949-040250-002	Resistor Network, Variable Resonator Input No. 1 (R15, R20, R21 thru R28)*	1
N3	949-040251-002	Resistor Network, Variable Resonator Input No. 2 (R16, R19, R29 thru R36)*	1
N4	949-040252-002	Resistor Network, Variable Resonator Input No. 3 (R17, R18, R37 thru R44)*	1
N5,N6,N7	949-040249-001	Resistor Network, Variable Resonator Output No. 1 (R51 thru R54, R61 thru R64, R73 thru R76)*	3
N8	949-040246-001	Resistor Network, Variable Resonator Output No. 2 (R83 thru R90)*	1
N9	949-040247-001	Resistor Network, Variable Resonator Output No. 3 (R91 thru R98)*	1
P81	910-040301-003	Header, Printed Circuit, 3 Pin (0.15 Centers), AMP640057-3	1
P82,P83,P85, P87	910-040301-007	Header, Printed Circuit, 7 Pin, (0.15 Centers), AMP640057-7	4
P84	910-040301-004	Header, Printed Circuit, 4 Pin, (0.15 Centers), AMP640057-4	1
P86	910-040301-006	Header, Printed Circuit, 6 Pin, (0.15 Centers), AMP640057-6	1
P88	910-040303-005	Header, Printed Circuit, Keyed, 5 Pin, (0.15 Centers), AMP640242-5	1
		* See Schematic Diagram for Resistor Values	

TABLE 5-2
POLYMOOG FIXED AND VARIABLE RESONANT FILTERS PRINTED CIRCUIT TC BOARD 8 ASSEMBLY REPLACEMENT PARTS LIST (Continued)

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
Q1	991-041051-001	Transistor, NPN, 2N3904	1
Q2	991-041052-001	Transistor, PNP, 2N3906	1
R4,R9,R10, R99 thru R105	852-312104-001	Resistor, 100K Ohm, ±5%, 1/4W	10
R45	852-312753-001	Resistor, 75K Ohm, ±5%, 1/4W	1
R46	852-312470-001	Resistor, 47 Ohm, ±5%, 1/4W	1
R47,R106	852-312102-001	Resistor, 1K Ohm, ±5%, 1/4W	2
R48	852-312682-001	Resistor, 6.8K Ohm, ±5%, 1/4W	1
R49	852-312331-001	Resistor, 330 Ohm, ±5%, 1/4W	1
R50	852-312392-001	Resistor, 3.9K Ohm, ±5%, 1/4W	1
R55,R65,R77	852-312471-001	Resistor, 470 Ohm, ±5%, 1/4W	3
R56,R57,R66, [illegible] R78,R79	852-312242-001	Resistor, 2.4K Ohm, ±5%, 1/4W	6
R71,R72	852-312103-001	Resistor, 10K Ohm, ±5%, 1/4W	2
	980-040492-004	Standoff, PEM KF2-832	16
	906-040307-007	Socket, Integrated Circuit, 7 Pin, SIL, AMP1-583773-4	4
	906-040307-008	Socket, Integrated Circuit, 8 Pin, SIL, AMP1-583773-5	4
	906-040307-010	Socket, 10 Pin, SIL, AMP1-583773-3	3
	910-040299-006	Header, Printed Circuit, 6 Pin, (0.1 Centers), AMP640098-6	8

TABLE 5-3
POLYMOOG STRING FILTER BOARD NO. 1 PRINTED CIRCUIT TC BOARD 8 ASSEMBLY REPLACEMENT PARTS LIST (Version 1)

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-040352-001	Printed Circuit Board Assembly consisting of:	
A1	991-041102-001	Integrated Circuit, Dual Operational Amplifier, MC1458CP-1	1
C1	946-040229-223	Capacitor, Polyester, 0.022uf	1
C2	947-042020-501	Capacitor, Disc, 500pf	1
C3	946-040229-474	Capacitor, Polyester, 0.047uf	1
R1	852-312913-001	Resistor, 91K Ohm, ±5%, 1/4W	1
R2,R3	852-312433-001	Resistor, 43K Ohm, ±5%, 1/4W	2
R4	852-312473-001	Resistor, 47K Ohm, ±5%, 1/4W	1
R5	852-312105-001	Resistor, 1 Megohm, ±5%, 1/4W	1
S1	910-040402-001	Receptacle, Bottom Entry, CIS, 6 Pin, (0.1 Centers), AMP3-380949-1	1

TABLE 5-4

POLYMOOG STRING FILTER BOARD NO. 1 PRINTED CIRCUIT TC BOARD 8 ASSEMBLY REPLACEMENT PARTS LIST (Version 2)

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-040352-001	String Filter Board No. 1 Printed Circuit Board Assembly, consisting of:	
A1	991-041102-001	Integrated Circuit, Dual Operational Amplifier MC1458CP-1	1
C1	946-040229-223	Capacitor, Polyester, 0.22uf	1
C2	946-040229-102	Capacitor, Polyester, 0.001uf	1
C3	946-040229-474	Capacitor, Polyester, 0.47uf	1
R1	852-312913-001	Resistor, 91K Ohm, ±5%, 1/4W	1
R2	852-312823-001	Resistor, 82K Ohm, ±5%, 1/4W	1
R3	852-312333-001	Resistor, 33K Ohm, ±5%, 1/4W	1
R4	852-312473-001	Resistor, 47K Ohm, ±5%, 1/4W	1
R5	852-312105-001	Resistor, 1 Megohm, ±5%, 1/4W	1
S1	910-040402-001	Receptacle, Bottom Entry, CIS, 6 Pin, (0.1 Centers), AMP3-380949-1	1

TABLE 5-5

POLYMOOG PIANO FILTER BOARD NO. 2 PRINTED CIRCUIT TC BOARD 8 ASSEMBLY REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-040356-001	Piano Filter Board No. 2 Printed Circuit Board Assembly, consisting of:	
A1,A2	991-041102-001	Integrated Circuit, Dual Operational Amplifier, MC1458CP-1	2
C1,C2	946-040229-683	Capacitor, Polyester, 0.068uf	2
C3	946-040229-124	Capacitor, Polyester, 0.12uf	1
C4,C5	946-040229-332	Capacitor, Polyester, 0.0033uf	2
C6	946-040229-103	Capacitor, Polyester, 0.01uf	1
C7	946-040229-104	Capacitor, Polyester, 0.1uf	1
R1,R4	852-312393-001	Resistor, 39K Ohm, ±5%, 1/4W	2
R3	852-312103-001	Resistor, 10K Ohm, ±5%, 1/4W	1
R5	852-312432-001	Resistor, 4.3K Ohm, ±5%, 1/4W	1
R6,R7	852-312473-001	Resistor, 47K Ohm, ±5%, 1/4W	2
R8	852-312472-001	Resistor, 4.7K Ohm, ±5%, 1/4W	1
R9	852-312105-001	Resistor, 1 Megohm, ±5%, 1/4W	1
S1	910-040402-001	Receptacle, Bottom Entry, CIS, 6 Pin (0.1 Centers), AMP3-380949-1.	1

TABLE 5-6
POLYMOOG ORGAN FILTER BOARD NO. 3 PRINTED CIRCUIT TC BOARD 8 ASSEMBLY
REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-040360-001	Organ Filter Board No. 3 Printed Circuit Board Assembly, consisting of:	
A1,A2	991-041102-001	Integrated Circuit, Dual Operational Amplifier, MC1458CP-1	2
C1,C2	946-040229-104	Capacitor, Polyester, 0.1uf	2
C3	946-040229-474	Capacitor, Polyester, 0.47uf	1
C4 thru C7	946-040229-103	Capacitor, Polyester, 0.01uf	4
R1	852-312823-001	Resistor, 82K Ohm, ±5%, 1/4W	1
R2	852-312362-001	Resistor, 3.6K Ohm, ±5%, 1/4W	1
R3,R11	852-312363-001	Resistor, 36K Ohm, ±5%, 1/4W	2
R4,R10, R13,R14	852-312223-001	Resistor, 22K Ohm, ±5%, 1/4W	4
R5	852-312104-001	Resistor, 100K Ohm, ±5%, 1/4W	1
R6	852-312105-001	Resistor, 1 Megohm, ±5%, 1/4W	1
R7	852-312434-001	Resistor, 430K Ohm, ±5%, 1/4W	1
R8	852-312562-001	Resistor, 5.6K Ohm, ±5%, 1/4W	1
R9	852-312134-001	Resistor, 130K Ohm, ±5%, 1/4W	1
R12	852-312272-001	Resistor, 2.7K Ohm, ±5%, 1/4W	1
S1	910-040402-001	Receptacle, Bottom Entry, CIS, 6 Pin (0.1 Centers), AMP3-380949-1	1

TABLE 5-7
POLYMOOG HARPSICHORD FILTER BOARD NO. 4 PRINTED CIRCUIT TC BOARD 8 ASSEMBLY
REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-040364-001	Harpsichord Filter Board No. 4 Printed Circuit Board Assembly, consisting of:	
A1	991-041102-001	Integrated Circuit, Dual Operational Amplifier, MC1458CP-1	1
C1,C3	946-040229-103	Capacitor, Polyester, 0.01uf	2
C2	947-042336-221	Capacitor, Disc, 220pf	1
C4	946-040299-104	Capacitor, Polyester, 0.1uf	1
C5	947-042020-501	Capacitor, Disc, 500pf	1
R1,R2	852-312472-001	Resistor, 4.7K Ohm, ±5%, 1/4W	2
R3	852-312224-001	Resistor, 220K Ohm, ±5%, 1/4W.	1
R4	925-040266-001	Resistor, Trim Pot, 10K Ohm	1
R5,R8	852-312105-001	Resistor, 1 Megohm, ±5%, 1/4W	2
R6	852-312243-001	Resistor, 24K Ohm, ±5%, 1/4W	1
R7	852-312473-001	Resistor, 47K Ohm, ±5%, 1/4W	1
S1	910-040402-001	Receptacle, Bottom Entry, CIS, 6 Pin (0.1 Centers), AMP3-380949-1	1

TABLE 5-8
POLYMOOG FUNK FILTER BOARD NO. 5 PRINTED CIRCUIT TC BOARD 8 ASSEMBLY REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-040360-001	Funk Filter Board No. 5 Printed Circuit Board Assembly, consisting of:	
A1,A2	991-041102-001	Integrated Circuit, Dual Operational Amplifier, MC1458CP-1	2
C1,C2	946-040229-104	Capacitor, Polyester, 0.1uf	2
C3	946-040229-474	Capacitor, Polyester, 0.47uf	1
C4,C5	946-040229-103	Capacitor, Polyester, 0.01uf	2
C6,C7	946-040229-102	Capacitor, Polyester, 0.001uf	2
R1	852-312563-001	Resistor, 56K Ohm, ±5%, 1/4W	1
R2	852-312362-001	Resistor, 3.6K Ohm, ±5%, 1/4W	1
R3,R9	852-312363-001	Resistor, 36K Ohm, ±5%, 1/4W	2
R4,R10	852-312223-001	Resistor, 22K Ohm, ±5%, 1/4W	2
R5	852-312114-001	Resistor, 110K Ohm, ±5%, 1/4W	1
R6,R7	852-312105-001	Resistor, 1 Megohm, ±5%, 1/4W	2
R8	852-312272-001	Resistor, 2.7K Ohm, ±5%, 1/4W	1
R11	852-312473-001	Resistor, 47K Ohm, ±5%, 1/4W	1
R12	852-312562-001	Resistor, 5.6K Ohm, ±5%, 1/4W	1
R13	852-312474-001	Resistor, 470K Ohm, ±5%, 1/4W.	1
R14	852-312114-001	Resistor, 110K Ohm, ±5%, 1/4W	1
S1	910-040402-001	Receptacle, Bottom Entry, CIS, 6 Pin (0.1 Centers), AMP3-380949-1.	1

TABLE 5-9
POLYMOOG CLAVINET FILTER BOARD NO. 6 PRINTED CIRCUIT TC BOARD 8 ASSEMBLY REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-040370-001	Clavinet Filter Board No. 6 Printed Circuit Board Assembly, consisting of:	
A1,A2	991-041102-001	Integrated Circuit, Dual Operational Amplifier, MC1458CP-1	2
C1	946-040229-332	Capacitor, Polyester, 0.0033uf	1
C2,C3	946-040229-102	Capacitor, Polyester, 0.001uf	2
C4	946-040229-153	Capacitor, Polyester, 0.015uf	1
C5	946-040229-104	Capacitor, Polyester, 0.1uf	1
C6,C7	946-040229-123	Capacitor, Polyester, 0.012uf	2
C8,C9	946-040229-333	Capacitor, Polyester, 0.033uf	2
R1,R6, R7,R16	852-312473-001	Resistor, 47K Ohm, ±5%, 1/4W	4
R2	852-312273-001	Resistor, 27K Ohm, ±5%, 1/4W	1
R3	852-312243-001	Resistor, 24K Ohm, ±5%, 1/4W	1
R4	852-312114-001	Resistor, 110K Ohm, ±5%, 1/4W.	1
R5	852-312682-001	Resistor, 6.8K Ohm, ±5%, 1/4W	1
R8	852-312105-001	Resistor, 1 Megohm, ±5%, 1/4W	1

TABLE 5-9

POLYMOOG CLAVINET FILTER BOARD NO.6 PRINTED CIRCUIT TC BOARD 8 ASSEMBLY REPLACEMENT PARTS LIST (Continued)

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
R9,R10,R13, R15	852-312563-001	Resistor, 56K Ohm, ±5%, 1/4W	4
R11	852-312333-001	Resistor, 33K Ohm, ±5%, 1/4W	1
R12	852-312103-001	Resistor, 10K Ohm, ±5%, 1/4W	1
R14	852-312153-001	Resistor, 15K Ohm, ±5%, 1/4W	1
R17	852-312154-001	Resistor, 150K Ohm, ±5%, 1/4W.	1
R18	852-312912-001	Resistor, 9.1K Ohm, ±5%, 1/4W	1
S1	910-040402-001	Receptacle, Bottom Entry, CIS, 6 Pin, (0.1 Centers), AMP3-380949-1	1

TABLE 5-10

POLYMOOG VIBES FILTER BOARD NO. 7 PRINTED CIRCUIT TC BOARD 8 ASSEMBLY REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-040374-001	Vibes Filter Board No. 7 Printed Circuit Board Assembly, consisting of:	
A1	991-041101-001	Integrated Circuit, Operational Amplifier, 741	1
C1,C2	946-040229-103	Capacitor, Polyester, 0.01uf	2
C3	946-040229-104	Capacitor, Polyester, 0.1uf	1
R1	852-312113-001	Resistor, 11K Ohm, ±5%, 1/4W	1
R2	852-312512-001	Resistor, 5.1K Ohm, ±5%, 1/4W	1
R3	852-312333-001	Resistor, 33K Ohm, ±5%, 1/4W	1
R4	852-312105-001	Resistor, 1 Megohm, ±5%, 1/4W	1
S1	910-040402-001	Receptacle, Bottom Entry, CIS, 6 Pin (0.1 Centers), AMP3-380949-1	1

TABLE 5-11

POLYMOOG BRASS FILTER BOARD NO. 8 PRINTED CIRCUIT TC BOARD 8 ASSEMBLY REPLACEMENT PARTS LIST (Version 1)

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-040374-001	Brass Filter Board No. 8 Printed Circuit Board Assembly, consisting of:	
A1	991-041101-001	Integrated Circuit, Operational Amplifier, 741	1
C1,C2	946-040229-102	Capacitor, Polyester, 0.001uf	2
C3	946-040229-474	Capacitor, Polyester, 0.47uf	1
R1,R2	852-312913-001	Resistor, 91K Ohm, ±5%, 1/4W	2
R3	852-312184-001	Resistor, 180K Ohm, ±5%, 1/4W.	1
R4	852-312105-001	Resistor, 1 Megohm, ±5%, 1/4W	1
S1	910-040402-001	Receptacle, Bottom Entry, CIS, 6 Pin, (0.1 Centers), AMP3-380949-1	1

TABLE 5-12

POLYMOOG BRASS FILTER BOARD NO. 8 PRINTED CIRCUIT TC BOARD 8 ASSEMBLY
REPLACEMENT PARTS LIST (Version 2)

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-040653-001	Mode Filter for Brass Printed Circuit Board Assembly, consisting of:	
A1	991-041102-001	Integrated Circuit, Dual Operational Amplifier, MC1458CP-1	1
C1,C3	946-040229-103	Capacitor, Polyester, 0.01uf	2
C2,C4	946-040229-472	Capacitor, Polyester, 0.0047uf	2
C5	946-040229-474	Capacitor, Polyester, 0.47uf	1
R1	852-312133-001	Resistor, 13K Ohm, ±5%, 1/4W	1
R2	852-312102-001	Resistor, 1K Ohm, ±5%, 1/4W	1
R3	852-312124-001	Resistor, 120K Ohm, ±5%, 1/4W	1
R4,R9	852-312472-001	Resistor, 4.7K Ohm, ±5%, 1/4W	2
R5	852-312105-001	Resistor, 1 Megohm, ±5%, 1/4W	1
R6	852-312223-001	Resistor, 22K Ohm, ±5%, 1/4W	1
R7	852-312181-001	Resistor, 180 Ohm, ±5%, 1/4W	1
R8	852-312104-001	Resistor, 100K Ohm, ±5%, 1/4W.	1
S1	910-040402-001	Receptacle, Bottom Entry, CIS, 6 Pin, (0.1 Centers), AMP3-380949-1	1

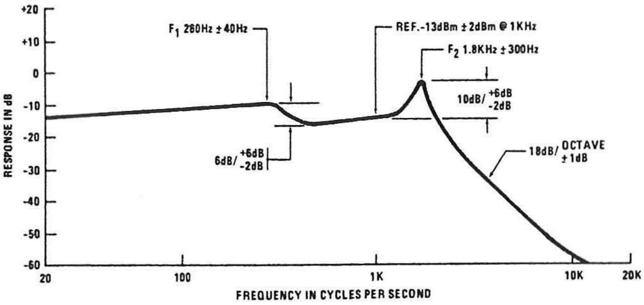
5.6 POLYMOOG KEYBOARD AUDIO CIRCUIT DESCRIPTION TC BOARD 8

(Reference Figure 5-2)

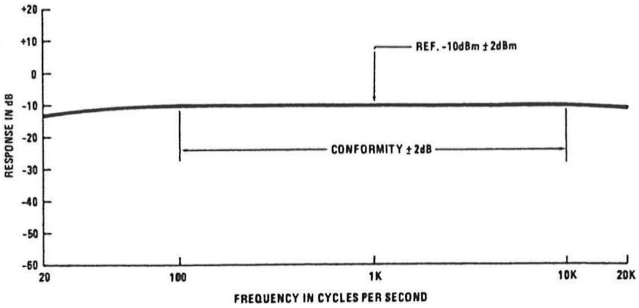
The AUDIO circuit board (TC board consisting of filter boards 1 and 2) in the Polymoog Keyboard combines and filters the audio outputs from the three MOTHER boards. All audio circuits on this board are referenced to a voltage rail derived from the +5 (Vcc) by AC bypasses to the rear panel AUD GND. This audio reference rail is labeled Vchr. The derivation of the audio rail is shown in the far right bottom of the schematic. The +5 VDC is bypassed with the RC network comprised of R53 and C17 and buffered by the voltage follower A5. The Vchr rail is applied to the low, medium and high mother boards and the front panel board in addition to serving as the on board audio reference rail. It should be noted that the outputs from the modulator cards on the mother board are differential currents which are converted to a single voltage drive referenced to this Vchr rail. Thus all audio in the system is referenced AC-wise to the rear panel ground, picked off at the J9 MAIN OUT rear panel connector.

The audio signals from the three MOTHER boards enter at connector P84 pins 4, 5, 6 and are summed for a composite audio signal via R1 through R4 and amplifier A1A. The output of this amplifier is the "direct output," applied via R5, C1 and connector P84 pin 1. This summed, direct signal is applied to two audio filter boards via S85-1 and S86-1 and to the voltage controlled filter via C4 and R30. The two filter boards contain fixed filters for ten of the presets. The voltage controlled filter is the audio path for presets 9 and 10 (BRASS). The audio outputs from the two filter boards and from the voltage controlled filter are applied to the filter selection analog switch selectors, IC1 and IC2, which select the appropriate filtered version for a particular preset. The inputs to these selectors are shown on the left hand side of the IC's. The audio outputs from these selector IC's are on pin 3 and feed the selected audio signal to the volume control circuit (SWELL circuit) via C2 and R17. The digital control signals for selecting the appropriate output from IC1 and IC2 are applied to pins 6, 9, 10 and 11.

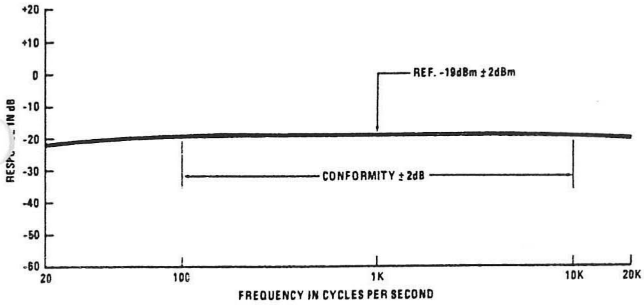
When the BASS FILTER is activated from the front panel, the audio signal from the MOTHER board applied to the direct summer via P84-6 is defeated and instead the audio output from the lower two octaves is applied to the bass filter via P84 pin 2. This bass filter consists of amplifiers A3A and A3B and associated components. The output of the bass filter is applied to the front panel BASS LEVEL control (R55) via P83 pin 5 and is returned by switching networks on the front control board to pin P84 pin 7 which routes the bass filter signal to the SWELL control circuit via C5 and R18. Thus the



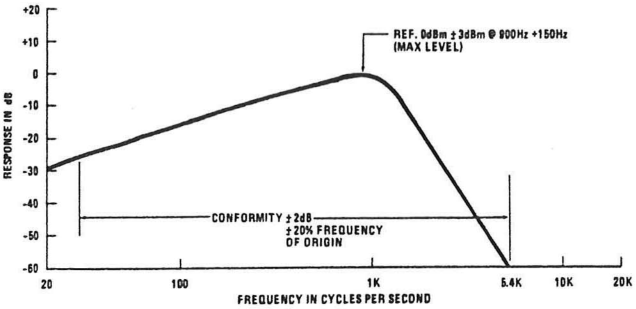
Vox Humana Preset No. 1



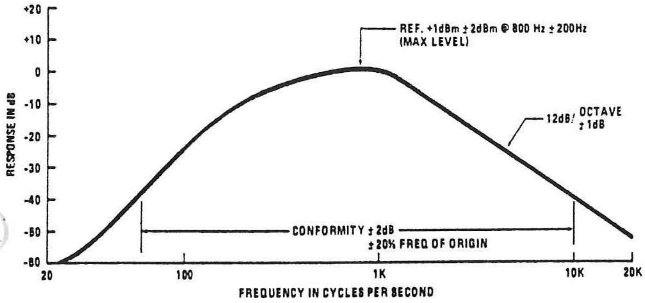
String 1 Preset No. 2



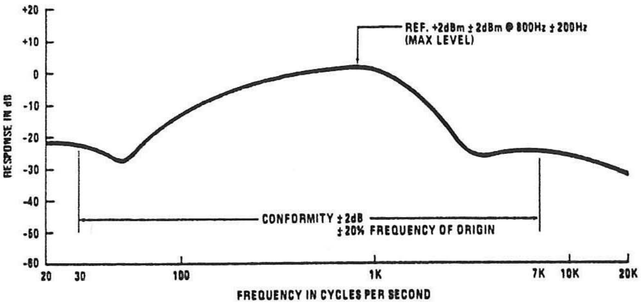
String 3 Preset No. 3



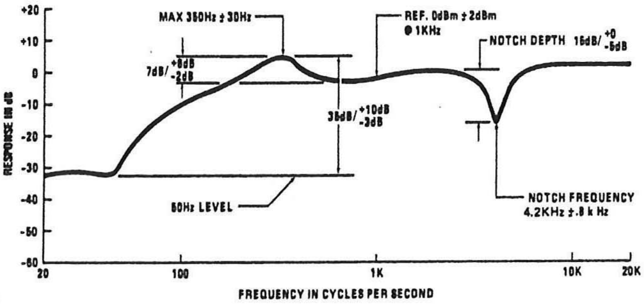
Electric Piano Preset No. 4



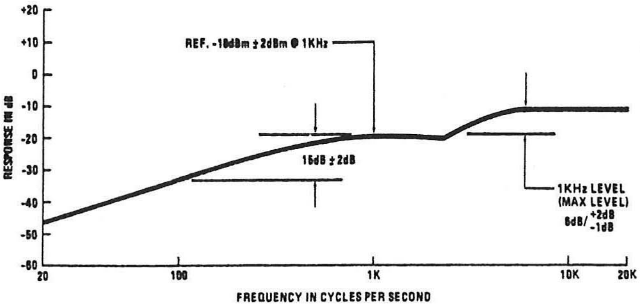
Piano Preset No. 5



Honky Tonk Piano Preset No. 6

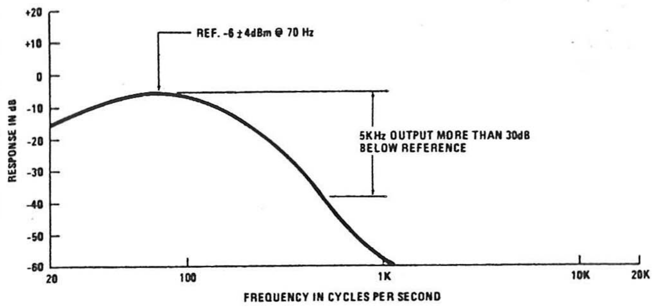


Clav Preset No. 7

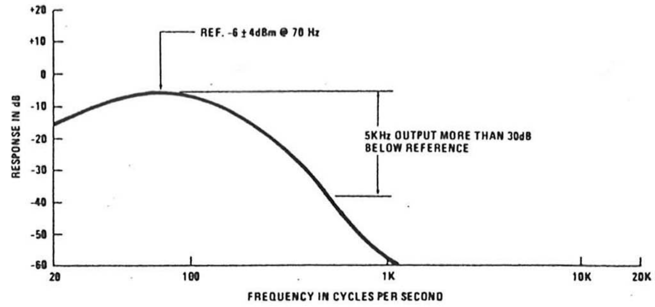


Harpsichord Preset No. 8

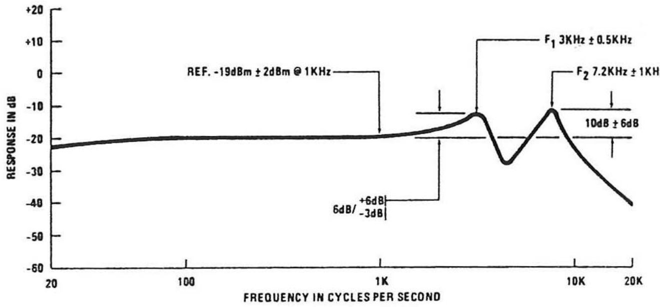
FIGURE 5-2 POLYMOOG KEYBOARD FREQUENCY RESPONSE OF FILTERS 1 THRU 14 AND BASS FILTER



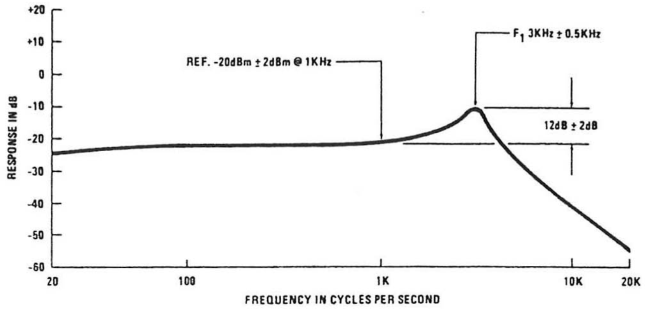
Brass Preset No. 9



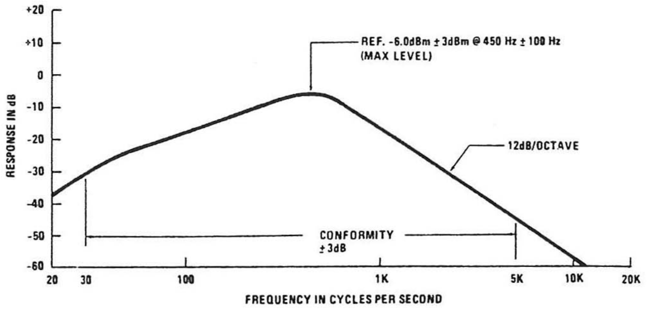
Brass Chorus Preset No. 10



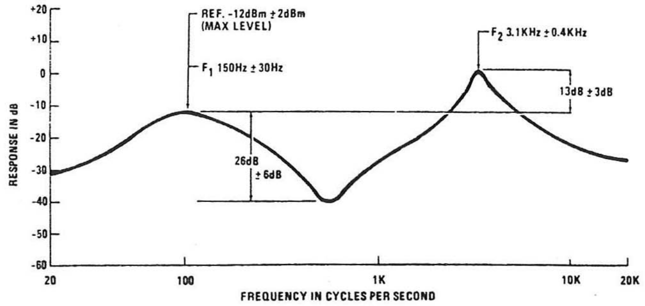
Pipe Organ Preset No. 11



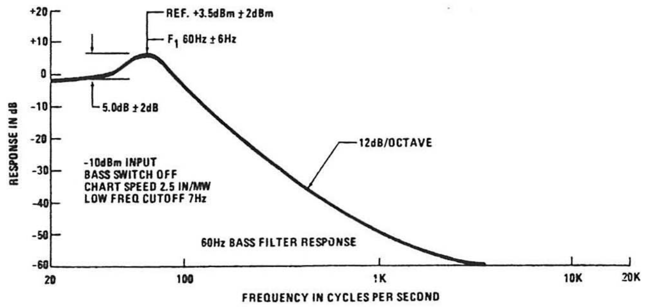
Rock Organ Preset No. 12



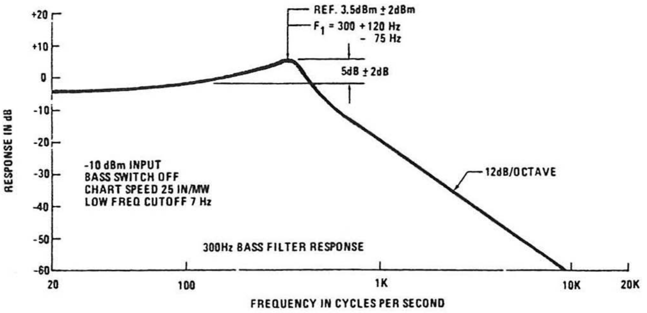
Vibes Preset No. 13



Funk Preset No. 14



60 Hz Bass Filter Response



300 Hz Bass Filter Response

FIGURE 5-2 POLYMOOG KEYBOARD FREQUENCY RESPONSE OF FILTERS 1 THRU 14 AND BASS FILTER (Continued)

audio signal applied to the positive input of amplifier A1B is the sum of the selected filtered MOTHER board signals and the BASS FILTER, if it is active.

The BASS FILTER is comprised of resistors R37 through R43, amplifiers A3A and A3B, capacitors C11 and C12 and the associated front panel frequency control potentiometers R54A and R54B. The bass filter is a standard state variable circuit with a Q of 3 and frequency range of 60Hz to 300Hz. The SWELL control circuit is comprised of Q1, Q2, A1B, and associated components. The SWELL control signal, injected on the J7 SWELL rear panel connector, ranges from 0 to 5 VDC. This control signal is filtered with the network comprised of R15 and C3 and applied to the exponentiating circuit comprised of Q1, R16 and Q2 via the resistor divider R13 and R14. The exponentiating circuit is biased with the SWELL range control R11 which sets the bias point for Q1 and Q2. This circuit converts the control signal applied to the rear panel to an exponential current which drives the LED in the photocell circuit (PC1) via the current limit resistor R20. The photocell circuit attenuates the sum of the selected filtered audio signal and the bass filter via R21 and the cell resistor. When the LED is at maximum brightness, maximum attenuation occurs. This condition in turn occurs when 0 volts is applied to the J7 rear panel SWELL input connector. The SWELL range control R11 is set so that 1dB of attenuation occurs with no input applied to J7. Amplifier A1B is a voltage follower with a gain of 8. This amplifier drives the front panel VOLUME control R56 via R24 and P83 pin 1. The front panel attenuated signal is then coupled to the rear panel MAIN OUT connector via the 1.0 uf coupling capacitor (C1) located on the LHC (left hand control) printed circuit board 8.

The voltage controlled filter, used for presets 8 and 9, is driven from the direct signal via C4 and R30 presenting a RMS signal level of approximately 20mV to the base of Q11. The voltage control filter is comprised of Q3 through Q14, the output amplifier, the external cutoff frequency drive amplifier A4B and associated components. Filter contour signal is injected on P81 pin 7 and the keyboard drive signal is injected on P81 pin 8. These two signals and the external cutoff control signal injected via R50 are summed on the load resistor R49 along with the range control current provided by the RANGE trim pot. R44 and the drive resistor R45 and applied to the base of the emitter follower Q14 and R48. This in turn drives the exponentiating transistor Q13 which acts as a current sink for the transistor ladder pairs comprised of Q3 through Q11. The audio signal injected at the base of Q11 traverses up the ladder and is filtered at each transistor stage with a cutoff frequency proportional to the standing current through the transistors. The differential signal appearing at the top of the ladder on the emitters of Q4 and Q3 is applied to the OTA gain recovery amplifier A2. This converts the low level audio signal at the top of the transistor ladder to an output voltage on pin 6 of A2 whose level depends on the bias current set by R32 and the output load resistor which is the parallel combination of R31 and R33. The output voltage signal is applied to the output preset selection gates in IC2 via C10. The range control is adjusted so that with 0 V applied to P81 pin 7 and VDC applied to P81 pin 8, the cutoff frequency of the filter is 200Hz. Frequency response of the filters is illustrated in Figure 5-2.

5.7 FILTER BOARD 1

Filter board 1 plugs into the top center board through connectors P86 and P87. This board contains six filters for presets No. 1, 4, 5, 6, 8, 11, 12 and 13.

Filter 1 (VOX HUMANA) is a simple highpass RC network comprised of R1 and R2 and a voltage follower, A1A. Resistors R1 and R2 can be used to gain scale the output. The cutoff frequency of this filter is 5.5kHz. Filter 4 (PIANO ELECT) consists of two stages. First, a two-stage lowpass filter comprised of A2A and associated components with a cutoff frequency of 1kHz followed by a single stage lowpass filter comprised of R6 and C4, followed by a second two-stage lowpass filter comprised of A2B and associated components with a cutoff frequency of 1kHz.

Filter 8 (HARPSICHORD), consists of two stages. The first stage is a filter with a shelf at 3kHz. The second stage is a high pass filter comprised of C21 and R44 followed by the buffer amplifier and the gain set resistor R45.

Filters 11 and 12, (PIPE ORGAN and ROCK ORGAN) use a common low pass filter section comprised of amplifier A3B and associated components. This low pass filter has a Q of 6 and a cutoff frequency of 7.2kHz and provides the rock organ signal via gain scaling resistors R21 and R22. This filtered output is added to that of a second low pass filter comprised of A3A and associated components. The second filter has a Q of 4.3 and a cutoff frequency of 3.0kHz. The two filters outputs are added together in the buffer amplifier A4B via the feed resistors R14 and R16 and the gain scaling feedback resistor R15 to provide the pipe organ output on S87-5 pin 5.

Filter board 2 contains filters for the CLAVINET preset 7 and the FUNK preset 14. The CLAVINET filter consists of three bandpass sections. The first section comprised of amplifier A1A and associated components has a center frequency of 4.2kHz and a Q of 1.5. The second section, composed of amplifier A1B and associated components, has a cutoff frequency of 335Hz and a Q of 2. The third section, consisting of amplifier A2A and associated components, has a cutoff frequency of 80Hz and a Q of 2. A fourth high pass section, consisting of C3 and R4 with a cutoff frequency of 225Hz, is combined with the outputs of the three band pass filters in amplifier A2B and the output scaling resistor R7.

The FUNK filter has three band pass sections associated with amplifiers A3A, A3B, and A4A. The first band pass filter associated with A3A has a cutoff frequency of 150Hz and a Q of 1.6. The second band pass filter associated with A3B has a cutoff frequency of 1.6kHz and a Q of 1.8. The third band pass filter associated with A4A has a cutoff frequency of 3.1kHz and a Q of 1.6. The outputs from these three band pass filters are combined in amplifier A4B and the output scaling resistor R26.

5.8 POLYMOOG KEYBOARD VOX HUMANA FILTER BOARD 14

This filter is comprised of three low pass filter sections associated with amplifiers A1A, A2A, A2B, respectively. The outputs from these three filter sections are summed via R5, R12, and R17 in the output amplifier A1B whose feedback resistor R6 determines the overall filter gain.

The first filter associated with A1A has a cutoff frequency of 1750Hz and a Q of 11. The second filter associated with A2A has a cutoff frequency of 330Hz and a Q of 2. The third filter associated with A2B has a cutoff frequency of 1600Hz and a Q of 1.

5.9 AUDIO CIRCUIT ALIGNMENT

5.9.1 VCF CUTOFF FREQUENCY

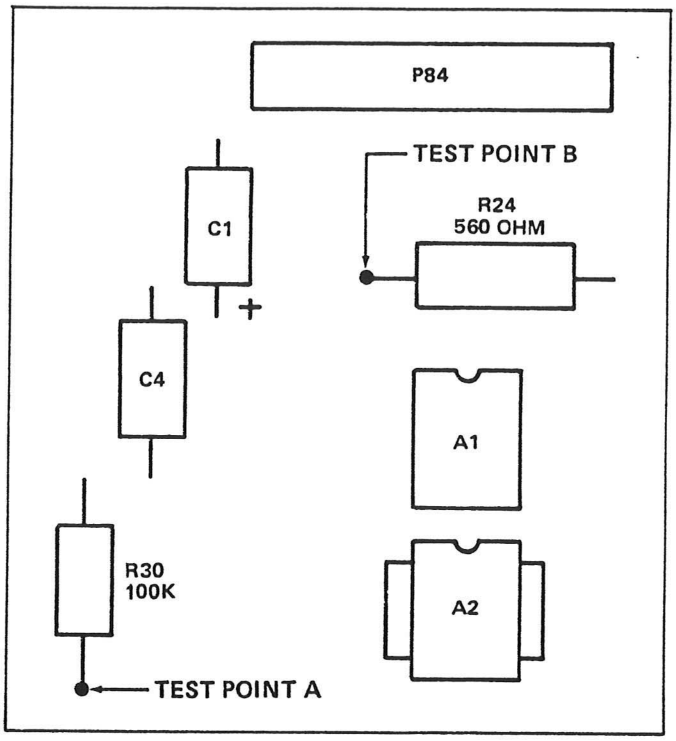
a. Depress preset No. 9.

b. Connect P81-7 to ground.

c. Connect P81-8 to +5VDC.

d. Place filter into oscillation by connecting a series 0.33uf precision capacitor and a 10K ohm ± 1% resistor from P83-1 to pin 2 of IC3. Refer to sketch, points A and B respectively.

e. Adjust R44 for 200Hz at main output.



PART OF AUDIO CIRCUIT BOARD

5.9.2 SWELL RANGE

a. Depress preset No. 9.

b. Depress A_4 and adjust trimpot R11 for maximum output; then slowly back off R11 until main output drops 1.0dB from full output. (10% drop in amplitude). Insert shorting plug in rear panel SWELL jack and observe reduction in output level of 30dB ± 3dB. Remove shorting plug.

5.10 KEYBOARD DISASSEMBLY

a. Disconnect power cord connector and all other rear panel connections.

b. Remove four screws securing cover to rear panel extrusion using a medium sized Phillips head screwdriver.

c. Loosen two captive knurled thumb screws under the instrument extreme front left and right sides until they turn freely and lift cover directly up.

d. Reconnect power cable and audio signal monitor.

e. All internal alignment and adjustment controls are now accessible.

5.11 TROUBLESHOOTING

Troubleshoot the audio circuit board using Table 5-13, printed circuit description paragraph 5.6, and parts location and the schematic diagrams in Volume II.

TABLE 5-13
POLYMOOG KEYBOARD AUDIO TC BOARD 8 TROUBLESHOOTING

PROBLEM	PROBABLE DEFECTIVE COMPONENT
No output in any preset	A1A, A1B, IC1, IC2
Voices with no filter effect	IC1, IC2, IC3, A2
Filter inoperative	IC3, Q5, Q6, Q7, Q8, Q9, Q10, R44 out of Calibration
Filter cutoff using pedal	A4B, Q14
Swell pedal has not effect	Q1, Q2
No bass filter output or cutoff	A4A, A3A, A3B, R54A, R54B, R55, C11, C12
No output from main output jack	IC1, IC2, A1B, R56
Some preset voices out	Filter Board IC1, IC2

TABLE 5-14

POLYMOOG KEYBOARD AUDIO CIRCUIT PRINTED CIRCUIT TC BOARD 8 ASSEMBLY REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-042495-001	Audio Circuit Printed Circuit Board Assembly, consisting of:	
A1	991-042908-001	Integrated Circuit, Dual Operational Amplifier, LF353	1
A2	991-041210-002	Integrated Circuit, Operational Amplifier, CA3094AE	1
A3,A4	991-041102-001	Integrated Circuit, Dual Operational Amplifier, MC1458CP-1	2
A5	991-041101-001	Integrated Circuit, Operational Amplifier, 741	1
C1	945-040209-001	Capacitor, Aluminum Electrolytic, 10uf, 25V	1
C2,C3,C6 thru C10,C19	946-040229-104	Capacitor, Polyester, 0.1uf	8
C11,C12	946-040229-683	Capacitor, Polyester, 0.068uf	2
C13	947-040200-103	Capacitor, Disc, 0.01uf	1
C14	946-040231-002	Capacitor, Tantalum, 10uf, 20V	1
C17	946-040229-224	Capacitor, Polyester, 0.22uf	1
C18	945-040209-004	Capacitor, Aluminum Electrolytic, 470uf, 16V	1
IC1,IC2	991-041090-002	Integrated Circuit, CMOS, CD4051BE	2
IC3	991-041104-001	Integrated Circuit, Resistor Array, CA3046	1
N1	949-042665-001	Resistor Network, VCF (R26 thru R29, R35, R36)*	1
P81,P84	910-040301-008	Header, Printed Circuit, 6 Pin, (0.150 Centers), AMP640057-8	2
P82	910-040303-006	Header, Printed Circuit, Keyed, 6 Pin, (0.150 Centers), AMP640242-6	1
P83	910-040301-006	Header, Printed Circuit, 6 Pin, (0.150 Centers), AMP640057-6	1
P85,P86,P87	910-040299-006	Header, Printed Circuit, 6 Pin, (0.1 Centers), AMP640098-6	3
PC1	948-041143-001	Optoelectric Relay, Sigma 301T1-2A2	1
Q1	991-041051-001	Transistor, NPN, 2N3904	1
Q2	991-041052-001	Transistor, PNP, 2N3906	1
Q5 thru Q10	991-042017-001	Transistor, NPN, 2N3392	6
Q14	991-041052-001	Transistor, PNP, 2N3906	1
R1,R3,R4,R41	852-312223-001	Resistor, 22K Ohm, ±5%, 1/4W	4
R2,R7,R8, R10,R39,R58	852-312103-001	Resistor, 10K Ohm, ±5%, 1/4W	6
R5,R24	852-312561-001	Resistor, 560 Ohm, ±5%, 1/4W	2
R6,R32,R34, R37,R43,R53	852-312104-001	Resistor, 100K Ohm, ±5%, 1/4W.	6
R9,R31,R49	852-312473-001	Resistor, 47K Ohm, ±5%, 1/4W	3
R11,R44	925-040266-002	Resistor, 100K Ohm, Trim Pot	2
R12	852-312124-001	Resistor,120K Ohm, ±5%, 1/4W	1
R13,R25	852-312562-001	Resistor, 5.6K Ohm, ±5%, 1/4W	2
R14,R19	852-312154-001	Resistor, 150K Ohm, ±5%, 1/4W	2
R15	852-312393-001	Resistor, 39K Ohm, ±5%, 1/4W	1
R16	852-312432-001	Resistor, 4.3K Ohm, ±5%, 1/4W	1
R17,R23,R48	852-312333-001	Resistor, 33K Ohm, ±5%, 1/4W	3
		* See Schematic Diagram for Resistor Values (± 5%, 1/4W)	

TABLE 5-14
POLYMOOG KEYBOARD AUDIO CIRCUIT PRINTED CIRCUIT TC BOARD 8 ASSEMBLY REPLACEMENT PARTS LIST (Continued)

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
R18	852-312683-001	Resistor, 68K Ohm, ± 5%, 1/4W	1
R20,R21	852-312101-001	Resistor, 100 Ohm, ± 5%, 1/4W	2
R22	852-312392-001	Resistor, 3.9K Ohm, ± 5%, 1/4W	1
R30	852-312104-001	Resistor, 100K Ohm, ± 5%, 1/4W.	1
R33	852-312153-001	Resistor, 15K Ohm, ± 5%, 1/4W	1
R38	852-312332-001	Resistor, 3.3K Ohm, ± 5%, 1/4W	1
R40,R42	852-312242-001	Resistor, 2.4K Ohm, ± 5%, 1/4W	2
R45,R47	852-312475-001	Resistor, 4.7 Megohm, ± 5%, 1/4W	2
R46,R51,R52	852-312225-001	Resistor, 2.2 Megohm, ± 5%, 1/4W	3
R50,R59	852-312105-001	Resistor, 1 Megohm, ± 5%, 1/4W	2
R57	852-312335-001	Resistor, 3.3 Megohm, ± 5%, 1/4W	1
	902-040942-004	Standoff, PEM KF2-832	4
	906-042012-008	Socket, Integrated Circuit, 8 Pin, DIP, AMP583640-1	2
	906-040307-007	Socket, Integrated Circuit, 7 Pin, SIL, AMP1-5837773-4	2
	906-040307-008	Socket, Integrated Circuit, 8 Pin, SIL, AMP1-5883773-5	4

TABLE 5-15
POLYMOOG KEYBOARD FILTER BOARD NO. 1 PRINTED CIRCUIT TC BOARD 8 ASSEMBLY REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-042511-001	Printed Circuit Baord Assembly, consisting of:	
A1 thru A7	991-041102-001	Integrated Circuit, Dual Operational Amplifier, MC1458CP-1	7
C2,C6,C9,C10	946-040229-102	Capacitor, Polyester, 0.001uf	4
C3,C4,C5, C15,C19,C21, C24	946-040229-103	Capacitor, Polyester, 0.01uf	7
C7,C8	946-040229-222	Capacitor, Polyester, 0.0022uf	2
C11,C12,C17, C18	946-040229-683	Capacitor, Polyester, 0.068uf	4
C13	946-040229-124	Capacitor, Polyester, 0.12uf	1
C14,C16	946-040229-332	Capacitor, Polyester, 0.0033uf	2
C20	947-042020-221	Capacitor, Disc, 220Pf	1
C22,C23	946-040229-153	Capacitor, Polyester, 0.015uf	2
C25	946-040229-333	Capacitor, Polyester, 0.33uf	1
C26	946-040229-393	Capacitor, Polyester, 0.039uf	1
N1	949-042666-001	Resistor Network, Piano (R3 thru R9)*	1
R1,R19,R20, R34,R46,R47, R48,R49	852-312223-001	Resistor, 22K Ohm, ± 5%, 1/4W	8
R2,R15,R22, R31,R39,R40	852-312472-001	Resistor, 4.7K Ohm, ± 5%, 1/4W	6
		* See Schematic Diagram for Resistor Values (± 5%, 1/4W)	

TABLE 5-15

POLYMOOG KEYBOARD FILTER BOARD NO. 1 PRINTED CIRCUIT TC BOARD 8 ASSEMBLY REPLACEMENT PARTS LIST (Continued)

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
R10,R17	853-422212-031	Resistor, 22.1K Ohm, ± 1%, 1/4W	2
R11,R12,R44	852-312243-001	Resistor, 24K Ohm, ± 5%, 1/4W	3
R13	853-423922-031	Resistor, 39.2K Ohm, ± 1%, 1/4W	1
R14,R16,R21	852-312104-001	Resistor, 100K Ohm, ± 5%, 1/4W	3
R15	852-312242-001	Resistor, 2.4K Ohm, ± 5%, 1/4W	1
R18	853-421212-031	Resistor, 12.1K Ohm, ± 1%, 1/4W	1
R23,R25,R33	852-312393-001	Resistor, 39K Ohm, ± 5%, 1/4W	3
R24,R26,R35, R36,R37,R38, R45,R50,R51, R52	852-312103-001	Resistor, 10K Ohm, ± 5%, 1/4W	10
R27	852-312432-001	Resistor, 4.3K Ohm, ± 5%, 1/4W	1
R28,R30	852-312473-001	Resistor, 47K Ohm, ± 5%, 1/4W	2
R29	852-312183-001	Resistor, 18K Ohm, ± 5%, 1/4W	1
R41	852-312224-001	Resistor, 220K Ohm, ± 5%, 1/4W.	1
R42	925-040266-001	Resistor, Trim Pot, 10K Ohm	1
R43	852-312105-001	Resistor, 1 Megohm, ± 5%, 1/4W	1
S6,S7	910-040402-001	Receptacle, Bottom Entry, CIS, 6 Pin, (0.1 Centers), AMP3-380949-1	2
S141	906-040302-005	Socket Housing, 5 Pln, (0.15 Centers), AMP640117-1	6

TABLE 5-16

POLYMOOG KEYBOARD FILTER BOARD NO. 2 PRINTED CIRCUIT TC BOARD 8 ASSEMBLY REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-042515-001	Printed Circuit Board Assembly, consisting of:	
A1 thru A4	991-041102-001	Integrated Circuit, Dual Operational Amplifier, MC1458CP-1	4
C1,C2	946-040229-102	Capacitor, Polyester, 0.001uf	2
C3	946-040229-332	Capacitor, Polyester, 0.0033uf	1
C4	946-040229-153	Capacitor, Polyester, 0.015uf	1
C5,C6	946-040229-123	Capacitor, Polyester, 0.012uf	2
C7,C8	946-040229-333	Capacitor, Polyester, 0.033uf	2
C9,C10	946-040229-104	Capacitor, Polyester, 0.1uf,	2
C11 thru C14	946-040229-103	Capacitor, Polyester, 0.01uf	4
R1	852-312273-001	Resistor, 27K Ohm, ± 5%, 1/4W	1
R2	852-312243-001	Resistor, 24K Ohm, ± 5%, 1/4W	1
R3	852-312114-001	Resistor, 110K Ohm, ± 5%, 1/4W,	1
R4,R6,R15, R29,R30	852-312473-001	Resistor, 47K Ohm, ± 5%, 1/4W	5
R5	852-312682-001	Resistor, 6.8K Ohm, ± 5%, 1/4W	1
R7,R22	852-312104-001	Resistor, 100K Ohm, ± 5%, 1/4W.	2

TABLE 5-16

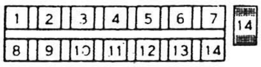
POLYMOOG KEYBOARD FILTER BOARD NO. 2 PRINTED CIRCUIT TC BOARD 8 ASSEMBLY REPLACEMENT PARTS LIST (Continued)

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
R8,R9,R10, R14	852-312563-001	Resistor, 56K Ohm, ± 5%, 1/4W	4
R11	852-312103-001	Resistor, 10K Ohm, ± 5%, 1/4W	1
R12	852-312333-001	Resistor, 33K Ohm, ± 5%, 1/4W	1
R13	852-312153-001	Resistor, 15K Ohm, ± 5%, 1/4W	1
R16	852-312154-001	Resistor, 150K Ohm, ± 5%, 1/4W	1
R17	852-312912-001	Resistor, 9.1K Ohm, ± 5%, 1/4W	1
R18	852-312822-001	Resistor, 8.2K Ohm, ± 5%, 1/4W	1
R19	852-312562-001	Resistor, 5.6K Ohm, ± 5%, 1/4W	1
R20,R24	852-312363-001	Resistor, 36K Ohm, ± 5%, 1/4W	2
R21,R25	852-312223-001	Resistor, 22K Ohm, ± 5%, 1/4W	2
R23	852-312272-001	Resistor, 2.7K Ohm, ± 5%, 1/4W	1
R26	852-312332-001	Resistor, 3.3K Ohm, ± 5%, 1/4W	1
R27,R28	852-312102-001	Resistor, 1K Ohm, ± 5%, 1/4W	2
S5	910-040402-001	Receptacle, Bottom Entry, 6 Pin, (0.1 Centers), AMP3-380949-1	1

TABLE 5-17

POLYMOOG KEYBOARD VOX HUMANA FILTER PRINTED CIRCUIT BOARD 14 ASSEMBLY REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-042861-001	Printed Circuit Board Assembly consisting of:	
A1,A2	991-041102-001	Integrated Circuit, Dual Operational Amplifier, MC1458CP-1	2
C1,C2,C5,C6	946-040229-103	Capacitor, Polyester, 0.01uf	4
C3,C4	946-040229-223	Capacitor, Polyester, 0.022uf	2
P141	910-040303-005	Header, Keyed, 5 Pin, 0.150 Centers, AMP640242-5	1
R1,R2	852-312912-001	Resistor, 9.1K Ohm, ± 5%, 1/4W	2
R3,R10	853-421002-031	Resistor, 10K Ohm, ± 1%, 1/4W	2
R4	853-421822-031	Resistor, 18.2K Ohm, ± 1%, 1/4W	1
R5	852-312303-001	Resistor, 30K Ohm, ± 5%, 1/4W	1
R6	852-312152-001	Resistor, 1.5K Ohm, ± 5%, 1/4W	1
R7	852-312822-001	Resistor, 8.2K Ohm, ± 5%, 1/4W	1
R8,R9	852-312223-001	Resistor, 22K Ohm, ± 5%, 1/4W	2
R11	853-421502-031	Resistor, 15K Ohm, ± 1%, 1/4W	1
R12	852-312273-001	Resistor, 27K Ohm, ± 5%, 1/4W	1
R13 thru R16	852-312103-001	Resistor, 10K Ohm, ± 5%, 1/4W	4
R17	852-312203-001	Resistor, 20K Ohm, ± 5%, 1/4W	1
R18	925-042389-008	Resistor, 2K Ohm, Trim Pot, Cermet	1



SECTION 6

BOARD 9

POLYMOOG VOLTAGE CONTROLLED FILTER AND KEYBOARD CIRCUIT AND POLYMOOG KEYBOARD PROGRAM CONTROL

TR

6.1 CIRCUIT DESCRIPTION - POLYMOOG

The voltage controlled filter and keyboard circuit printed circuit board assembly (TR) contains the following major sections: (1) trigger and monophonic keyboard circuits; (2) voltage controlled filter and associated circuitry; (3) brightness drive; (4) modulation oscillator and (5) output summing and drive circuitry. (See Volume II).

The upper left section of board 9 schematic (Volume II) contains a digital control logic section associated with VCF ON-OFF switching, FOOT SUSTAIN, LOWER-UPPER VCF switching and external trigger. When SVOO line is logic "O", the VCF is OFF forcing the outputs of G4 and G5 high and G8 and G9 low, turning off the audio feed signal from the mother boards via the FET gates and IC12. In addition, the output of G6 is forced high, forcing the output of G10 low (if no external trigger is applied to the CSTI line via CR2) holding down the reset line on the LM555 (IC5) and also holding the trigger line to IC5 high, because transistor Q3 is turned on via R57 to prevent the VCF contour generator from triggering when the VCF is off.

When the SVOO line is logic "1," gates G4, G5 and G6 are enabled permitting these gates to be controlled from the UPPER/LOWER switching line (SKL), ALL-SPLIT line (SKTM) and the internal trigger signal to G6 via R7. If the SKTM signal is a logic "0" (ALL mode), G1 is forced high, forcing G5 low and allowing SVCL, the low keyboard audio feed line, to be applied to the VCF. This ALL mode forces the SKL line to a logic "1" via a coupling on the control board, which causes the SVCH signal, the control line for the audio signal from the high mother board, to go high. If the SKTM line is a logic "1," gates G8 and G9 are controlled via G1, G4 and G5 and are in opposition, that is, either the SVCH or the SVCL line is a logic "1" under control of the SKL, the UPPER/LOWER switching signal.

Whenever the VCF is on, the SVOO line enables G6, permitting a trigger signal to be applied to G10 and subsequently to IC5 via R57.

When a key is depressed on the portion of the keyboard selected by the SKL line, the output of A5B goes positive. This d-c trigger is applied to G10, the drive for the VCF contour generator, and G12, the external trigger gate. The external trigger gate is enabled via the KCEX line, the external input trigger control line.

An a-c trigger is developed by amplifier A4B and consists of a negative going 5 millisecond pulse which is coupled to external S-trigger gate G12 via R28 and CR6. The d-c trigger signal from A5B initially causes G12 to go negative. Subsequent retriggers from A4B cause G12 to open for the 5 millisecond pulse duration. The open collector output of G12 (IC3) is paralleled with the open collector output of G13 (IC9), the single/multiple trigger control gate. The d-c trigger signal from A5B is also applied to G13 via R89. If the single/multiple trigger control KTSM is logic "0," the instrument is in the multiple trigger mode and gate G13 is disabled via R88 and CR13. If the instrument is in the single trigger mode, the KTSM line is positive and gate G13 is enabled. Therefore in the single trigger mode, the d-c trigger from A5B via G13 overrides any multiple triggering effect from G12 for the external S-trigger. The effect of G13 is further disabled when the external keyboard control is in the off mode via the ESOO line and CR12. The ESOO line is paralleled with the KCEX line and also defeats S-trigger action via gate G12.

Single/multiple trigger control of the VCF contour generator is accomplished via G14 in IC9. When the instrument is in the single trigger mode, namely, KTSM = "1," G14 is enabled to respond to the d-c trigger from A5B. When a d-c trigger occurs, the output of G14 goes negative turning on transistor Q3 via R94. However, there is a delay introduced via the RC network comprised of R93 and C48 so that the initial a-c trigger can be applied to IC5 from A4B through R28 and R58, before the d-c trigger turns on Q3.

Foot sustain (final decay control) is accomplished via the SFTEX or SVFTO lines. If either of these lines is a logic "0," the outputs of G2 and G3 are forced high. When G3 goes high, current is provided to the emitter of Q1 via R10 causing the FTSUBL, M and H lines to go from -5.5 to approximately 0 VDC causing final decay to occur on all modulators on each mother board. When final decay is on, the output of G2 is high causing the output of G7 to be low forcing the output of G11 high. This high output causes CR20 to be reverse biased and allows contour generator integrating capacitor C21 to operate (go positive). When the final decay is off, caused by both SFTEX and SVFTO lines being positive, G11 is enabled via G7. The output of G11 is controlled via the input on pin 1 of IC2 which is coupled to trigger control gate G6 via CR1. Whenever a key is depressed with the VCF ON, the output of G6 goes negative, causing the output of G11 to go positive, again allowing voltage to rise on contour capacitor C21. When no key is depressed and both SFTEX and SVFTO lines are logic "1" (off), the output of G11 is pulled to ground and the voltage across contour capacitor C21 is pulled to ground with a 10 milliseconds time constant via CR20 and R72. Thus, final decay control operates on both mother board modulator circuits and the filter contour generator simultaneously.

Whenever a key is depressed, a (minimum) current of 4 microamperes is applied to either trigger buss line TRGL or TRGH from the lower and upper keyboard sections, respectively. These currents are routed through FET current switches contained in IC7 and IC8 under control of the LOWER/UPPER control line, SKH. Either one or the other, or both, of these FETs are on depending upon whether the keyboard is in the UPPER, LOWER or ALL mode. When the VCF is in the ALL mode, the FET in IC8 is turned on via the inverter in IC7 and R34. In addition, the FET current switch in IC7 is turned on via gate G15 whose open collector resistor pulls up the base of Q25 (via reverse emitter base breakdown) to turn on the switch. If the VCF is in the SPLIT mode, then LOWER/UPPER trigger current switching is accomplished via the P channel inverter in IC7 and the subsequent inverter (also in IC7) comprised of the P and N channel FETs.

The selected trigger currents are routed to summing amplifier A5A which generates a (minimum) negative step of approximately 200 millivolts each time a new key is depressed. The output of A5A drives comparator A5B whose threshold is approximately 200 millivolts below the zero trigger signal output reference of A5A. Depression of one or more keys causes the output of A5B to swing from -15 to approximately 3.5 volts. This d-c trigger is applied to trigger control gate G6, external S-trigger gate G12 and single/multiple control gates G13 and G14. The d-c trigger enables the reset input of IC5 via R7, control gate G6 and AND gate G10.

The output of trigger summing amplifier A5A is coupled via C4 and R24 to a-c trigger generator A4B. In addition, the external trigger input on the CSTI line is coupled to this a-c trigger generator via C3 and R23. The positive input of A4B is biased to the -5.5 VDC rail via R25 and R24. The minus input reference is approximately 200 millivolts more negative, derived from divider resistors R15 and R16. Each time a key is depressed, a step waveform on A5A causes a 5 millisecond negative going pulse on A4B. A small amount of regeneration providing Schmitt trigger action is accomplished via R29 and C7. The a-c trigger output of A4B is coupled to trigger buffer amplifier A4A to provide a monophonic keyboard sample and hold pulse, to the contour generator via R28 and R58 and to the external S-trigger gate G12 via R28 and CR6. CR5 clamps the trigger applied to the contour generator and S-trigger gate G12 to ground.

The d-c trigger from A5B is also coupled via R18 to the STRING PRESET No. 1 contour generator comprised of A6A and B and associated components. A d-c trigger causes the output of A6A to rise to +13.5 VDC generating a contour with a rise time of 100 milliseconds, a fall time of 560 milliseconds and an amplitude of 13.5 volts to occur on the MACG line used to contour the amount of frequency and pulse width modulation when the instrument is in the string mode.

The VCF contour generator is comprised of IC5 A11, A12, A13, A10B, A10A, IC6, Q4, Q3 and associated components. This contour generator has current controlled attack time, decay time and sustain level. These currents enter on the PCATN, PCDEN and PCSUN lines, respectively. The sustain current generates a sustain level voltage on the output of A10B; the larger the sustain current, the lower the sustain level.

IC5 generates an internal control voltage of 10.0 VDC on pin 5. When IC5 is triggered, the output at pin 3 rises to 13.5 VDC and stays at this voltage until the threshold control voltage at pin 6 rises above the control voltage on pin 5. At this time, the output of IC5 resets to ground potential. Thus, when a note is depressed, IC5 is triggered and its output goes to 13.5 volts enabling gates C2 and C3 in IC6. Gate C2 is used as an inverter via R73 which drives gates C4 and C3 in opposition. In addition, gate C1 is enabled as long as any key is depressed.

The maximum output of sustain amplifier A10B is 11.0 volts. Assume A10B output is about 5.7 volts. When IC5 output goes to 13.5 volts, the voltage at the junction of R61 and R62 rises to 10 VDC and CR18 is reverse biased. During attack time, gate C3 in IC6 applies attack current on the PCATN line and to the current-level-converter section comprised of A10A, 4 and R69. This attack current is applied to the negative input of A10A causing the output of A10A to go sufficiently negative so that current flowing through R69 is equal to the attack current. This attack current is applied to pin 5 of A11 (CA3080) via the collector of Q4. In addition, a small amount of current is provided to pin 5 of the CA3080 (A11) via R68. Trim pot R70 and resistor R71 shunt part of this current provided by R68. Trim pot R70 is adjusted so when zero current is provided to the PCATN line (longest attack and decay), 1 microampere of current is delivered to the output from pin 6 of the CA3080 during attack and decay phases, providing 10 second attack and decay times.

A 10 volt signal at the junction of R61 and 62 is divided down by R62 and R67 and applied to pin 3 (the positive input) of A11. Assume the output of A11 (pin 6) attached to integrating capacitor C21 is initially at zero. The output of A12, a high input impedance buffer follower, is zero and voltage applied to a resistor divider comprised of trim pot R64, and resistors R65 and R66 and to the threshold input at pin 6 of IC5, is zero. The output at pin 6 of A11 will begin to rise at a rate determined by the current supplied by Q4 and the capacitance of C21. As this voltage rises, so does the output of A12 and thereby the feedback voltage applied to the negative input of A11 via trim pot R64 and resistors R65 and R66. The output of A11 will continue to rise until voltage on the negative and positive terminals are equal and ntour generator feedback trim pot R64 is adjusted so that this occurs when the voltage at the output of A12 is equal to the voltage at the junction of R61 and R62, namely, 10 volts during the attack phase. This feedback voltage from A12 is also applied to the threshold input at pin 6 of IC5 via R63. When this threshold voltage reaches 10 volts, the output of IC5 goes to zero. Diode CR16 is used to prevent the condition of simultaneous triggering and resetting on IC5 which might cause it to burst at high frequency. When the output at pin 3 of IC5 goes to zero, gates C2 and C3 of IC6 are disabled and gate C4 is enabled applying decay current on the PCDEN line to the current level translator (A10A and Q4) described previously. As mentioned previously, the sustain level voltage at the output of A10B is applied thru IC5 to R61 and R62 via CR15. Since the output at pin 3 of IC5 has now gone negative, voltage at the junction of R61 and R62 is equal to the output voltage of A10B of the sustain level controller minus a diode drop, which would be about 5.0 VDC according to our previous assumptions. The new "equilibrium" point for the output of A11 will be 5 volts instead of 10 volts as it was during the attack phase.

The CA3080 A11 now seeks this new equilibrium point at a rate determined by the bias current injected on pin 5 which is now the decay current. As long as any note is held, gate 1 of IC6 is open and CR20 is reverse biased and once this new equilibrium voltage is reached, it remains there. When all keys are released, one of two things occur depending on whether FINAL DECAY is on or off. If FINAL DECAY is on when all keys are released, gate 1 of IC6 closes and voltage applied to A11 via R62 drops to zero. In this case, the new equilibrium point for the output of A11 is zero and it seeks this new point at a rate determined by the decay current. As mentioned previously, final DECAY on implies that CR20 is reverse biased. If, for example, all keys are released and final decay is off, gate C1 is closed and the anode side of CR20 drops to zero rapidly pulling down the voltage across C21 from whatever sustain level was held while the keys were being depressed.

Contour generator feedback trim pot R64 is adjusted so the output of A12 goes to 11 volts with minimum attack and decay current, assuring that feedback voltage will reach 10.0 volts, the value required to reset IC5, and proceed to the contour sustain phase.

The buffered output of the VCF contour generator (pin 6 of A12) is applied to A13, the contour amount VCA via resistor divider R75 thru R78 to provide a voltage drive level proper for linear VCA action. Contour generator amount balance trim pot

R76 is set so that with bias current applied to pin 5 of A13, this contour amount VCA provides a current equal to the product of the divided down contour voltage and the contour amount current on the PCAMN line. Transistor Q10 provides a low impedance summing point for currents on the PCAMN line and translates this current to VCA A13 by its collector. The output current of contour amount VCA A13 is summed along with the modulation amount current from A9, the sample and hold amount current from A8 and VCF cutoff current at load resistor R83. This sum is applied to VCF current source Q11 and Q12 and is described later.

The VCF section contains a modulation oscillator comprised of A1, A2B and A3B which generates a triangular wave and a square wave. The triangular wave is used to modulate the cutoff frequency of the filter via a VCA and the square wave output is used to trigger a sample and hold circuit which samples a random noise source. The resulting random step pattern is applied to the cutoff frequency of the voltage controlled filter via a VCA.

Current controlling the modulation rate of the modulation oscillator is injected on the PVMRN line. This current is transferred to the bias input (pin 5) of A1 via a current translation circuit comprised of A2A, Q2 and R22. An additional fixed current of 1.5 microamperes is provided to this bias input via R26. A1 acts as a switched current source with bias current applied to pin 5 appearing at output pin 6 with a polarity determined by the input drive to pin 3. A2B is a high impedance follower driving a Schmitt trigger comprised of A3B, R30 and R27. The output of A3B is either fully negative or fully positive, that is, plus or minus 14 volts and sets a positive and negative threshold of approximately 2.5 volts on the positive input (pin 5) of A3B. At the same time, this threshold is used to switch the current polarity of A1. The current output of A1 causes the voltage to rise linearly on C1 and on the output of A2B until it reaches a value of +2.5 volts. At this time the output of A3B switches negative setting a threshold of -2.5 volts and also switching the current direction on the output of A1, reversing the voltage range. This action results in a triangular wave output at pin 7 of A2B of approximately 5 volts peak-to-peak which is applied to the modulation amount voltage controlled amplifier comprised of A9, R53, R54 and C20. Gain control of this VCA is accomplished via current injected on the PVMAN line. Transistor Q6 acts as a current level translator for the bias input to A9 and the modulation amount VCA current output of A9 is applied to the cutoff frequency summing node described previously.

The 28 volt peak-to-peak square wave is applied to the differentiating network comprised of C16 and R45 to provide a current pulse to sample and hold amplifier A7. This current pulse turns on amplifier A7 at which time sample and hold capacitor C17 is charged by the output current from pin 6 of A7 to a voltage such that the voltage appearing at the source of FET follower Q7 provides feedback current via R44 to satisfy conventional closed loop operational amplifier operation. Random noise source IC4 generates a random sequence of 13 volt pulses. A bypass network comprised of R40 and C13 prevents "hash" from occurring on the supply line to pin 4 of IC4. The output of the random noise source on pin 3 is a-c coupled via C14 and lowpass filtered via R42 and C15 and applied to the negative input node of A7 via R43. Thus, during the brief sampling period, a current which varies from sample to sample is fed to the summing node of A7 and the sampling pulse "closes the loop" for a brief interval. The result is a random step function on the output of source follower Q7 which is lowpass filtered to eliminate short overshoots via R48 and C18 and applied to the negative input at pin 2 of sample and hold amount VCA A8 via voltage divider network R49 and R50. Gain control of this sample and hold amount VCA is accomplished via current on the PVSHN line where Q5 acts as a current level translator to pin 5.

The monophonic keyboard system for external keyboard drive and for VCF keyboard drive is comprised of part of IC7, A14A, A14B, IC10, IC11, A15, A16, A17A, Q9 and associated components.

The monophonic section keyboard contains two independent resistor strings for the lower two octaves and upper four octaves. Each resistor in the string is 100 ohms and the total resistance for the lower string is 2400 ohms while total resistance for the top string is 4700 ohms. When a key is depressed, a switch connects a point on the resistor divider string to keyboard buss KBBS, common to both keyboard sections. A keyboard voltage is derived from either the lower or upper resistor string, but not both simultaneously. This is accomplished by applying a constant current source to either the upper or lower resistor string, but not both simultaneously. For example, if the upper string has current applied, the lower string is floating between reverse bias diodes. Figure 6-1 is a simplified drawing of this keyboard circuit showing the resistor strings. The FET switches in IC7 and IC8 apply a precision positive potential or an adjustable precision negative potential to R98 and R99. Voltage conditions shown are for application of current to the upper keyboard string. The 0.5 milliampere current drawn through R98 and R99 causes a current of equal magnitude to be drawn down through R_u', a dummy upper keyboard string. If R_u' is equal to R_u and if the drops across diodes CR1 and CR1′ are equal (true because both are carrying equal current and they are well matched diodes contained in a single integrated circuit package) and if R102 and R105 are well matched resistors, the high open loop gain of A14B will force the lower end of the upper keyboard resistor string, R_u to be precisely at 0.0 volt. If a section of the keyboard esistor string is shorted by depression of more than one note on the upper keyboard string, the upper potential of 2.35 VDC will remain constant since the lower leg of the circuitry attached to the plus input of A14B is an independent fixed feedback loop for A14A and applies 2.35 VDC to the lower resistor string. A similiar condition exists when a positive potential is applied to R98 and R99. It should be noted when the upper keyboard resistor string is carrying current, diodes CR2 and CR4 are reverse biased and the lower keyboard resistor string R_l is isolated from the upper keyboard string. Depression of a key on the lower part of the keyboard attaches some point on the R_l string to the keyboard buss and will not interfere or cause current to be drawn through the buss from the upper keyboard resistor string. Trim pots R100 and R103 provide a means of setting the lower voltage on the upper keyboard string precisely to the same voltage so that keyboard voltage is a continuous signal through the break in the keyboard sections. In addition these pots may be used to range the keyboard output voltage to drive a Minimoog or Micromoog.

When a key is depressed, a particular point on either the upper or lower keyboard strings is connected to keyboard buss KBBS. Simultaneously, a 5 millisecond positive going trigger pulse is developed and presented to gate 1 of IC11 (C1 line) opening the gate and storing the appropriate keyboard voltage across output capacitor C25. The keyboard voltage stored in capacitor C25 is buffered by high impedance amplifier A15 having an open loop gain of approximately 200 determined by R111, R107 and R108. A second feedback loop to achieve an approximate gain of two is accomplished via A16 and A17A. Whenever a new keyboard signal is acquired that is different from a previous value, the output of A15 switches current amplifier A16 via R112 and R113 causing the potential on glide capacitor C28 to slew in the proper direction so that the loop conditions comprised of A15, A16 and A17A are satisfied. The slew rate on glide capacitor C28

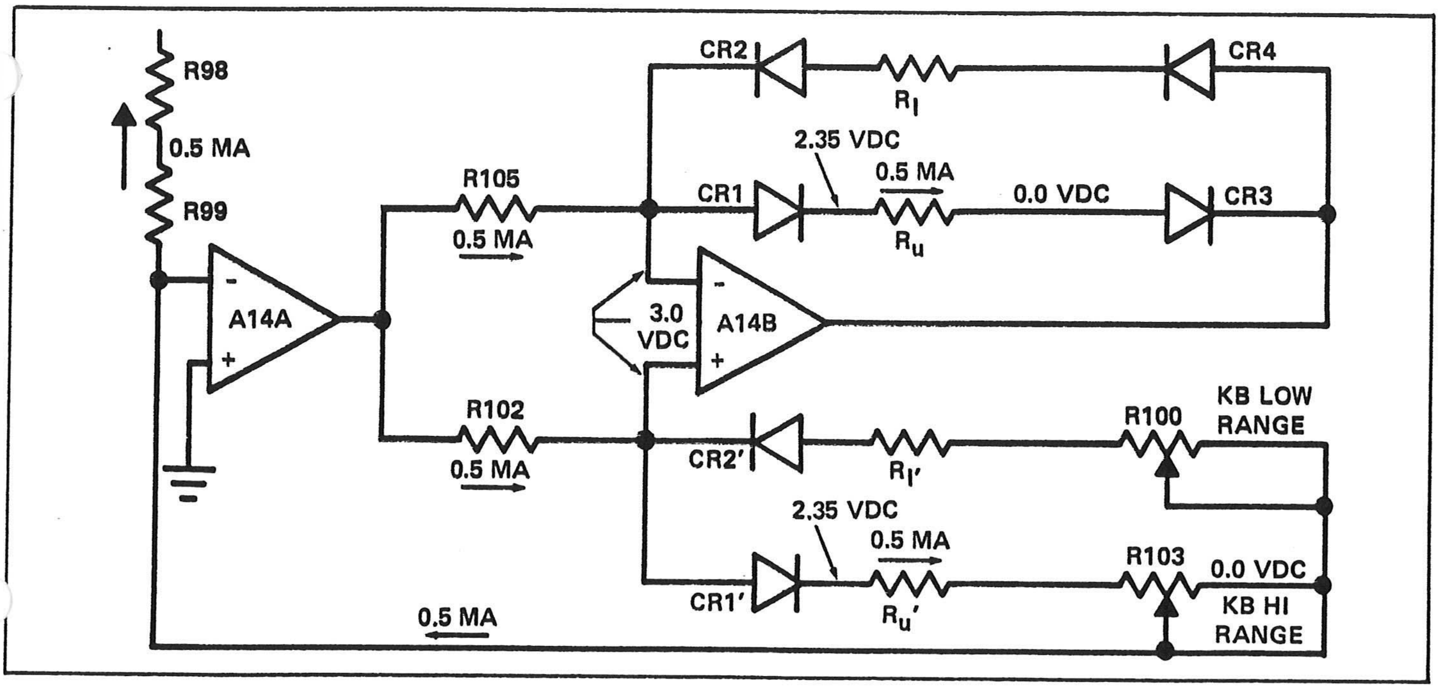


FIGURE 6-1 KEYBOARD CIRCUIT SIMPLIFIED DIAGRAM

is determined by the glide current introduced on the PKGLN line and transferred to the CA3080, A16, via current translation transistor Q9. R115 provides a minimum glide current of approximately 0.5 microampere. Amplifier A17A is a high impedance buffer amplifier providing drive to R107 and to the negative input of A15 closing the large feedback loop. Closure of the feedback loops around A17A and around the large feedback loop are accomplished via gate C2 of IC11 or via gates C3 and C4 of IC11. The external keyboard control KCEX line determines whether the C2 line or C4 and C3 control lines in IC11 are positive via the level translating and inverting gate contained in IC8. When the C2 line is positive, gate C2 is turned on, thereby serving as the feedback closure to R107. In this case, gates connected to outputs O_3 and O_4 are open and the external keyboard drive signal buss KBEX is open circuited. When gate C2 line is negative, C3 and C4 are positive applying the keyboard control voltage to the KBEX line from A17A via gate O_3 in IC11. Gate C4 serves as an isolated feedback return point to R107. This isolated return eliminates offsets due to the on resistance of the FET gates in IC11 when driving low impedance external loads. The rear panel KB SCALE variable resistor is connected between ground and the KBSC line and varies the overall loop gain between the voltage stored on sample and hold capacitor C25 and the keyboard output voltage on the KBEX line. However, variation of the rear panel KB SCALE variable resistor does not vary the voltage on the negative input of buffer amplifier A15, the point where the internal keyboard voltage drive to the VCF is derived. This internal keyboard voltage is applied to keyboard amount VCA A21 via divider network R175 and R174. Keyboard amount balance trim pot R172 provides VCA offset cancellation for the keyboard amount VCA. Current gain of keyboard amount VCA A21 is accomplished via level translator transistor Q17 and the N channel FET connected to pin 4 of IC14. Currently, control line SVVP is grounded turning on the N channel FET. This SVVP line is used to provide VAR-PRE control of glide current and is not currently used in the Polymoog. The output current of VCA A21 is applied to cutoff frequency summing load resistor R83 along with the previously mentioned contour amount current.

Audio inputs from the low, medium and high other boards enter the VCF board on the OUTLW, OUTMW and OUTHW lines. Gates C3 and C4 of IC12 selectively gate the audio signals from the lower, upper or both keyboard sections to gain recovery amplifier A18A, which simultaneously drives preset gain selector resistors R141 through R148 and preset drive resistor R149. The audio signal now passes through either a preset gain resistor or preset drive resistor R149, determined by the control signal on the SVVP line. Transistor Q13 is a level translator providing a 15 volt switching level activating either gate C2 in IC12 or one of eight gates in IC13. If for example, the collector of Q13 is a logic "0," one of the gates determined by encoded preset selection lines SPB1, SPB2 and SPB3 is turned on routing the signal to pin 3 of IC13 and to the audio input of the filter via C35. If the collector of Q13 is high, all gates in IC13 are inhibited and gate 2 in IC12 is on, applying audio input to the filter via R149 and C35. The VCF input level on pin 2 of IC15 is approximately 20 millivolts rms. The VCF in the Polymoog is the patented Moog filter using a pair of push-pull transistor ladders comprised of Q18 through Q23 and four transistors in IC15.

Transistor Q11 is an emitter follower for the composite cutoff frequency control signal and Q12 controls a current to the exponential current converter. This exponential current is applied to the double transistor ladder and, as collector current through Q12 is varied, the dynamic base emitter resistances of the transistors in the ladder vary in a tracking manner and, in conjunction with capacitors C36 through C39, provide a variable cutoff frequency. The differential output voltages from the top of the ladder, pins 7 and 10 of IC15, are applied to high impedance dual FET follower Q14 which drives two gain recovery amplifiers (CA3080s) A22 and A19. Gain recovery amplifier A22 provides feedback control to the transistor ladder. Emphasis amount trim pot R161 adjusts the amount of feedback voltage applied to pin 4 of IC15. Bias current injected onto pin 5 of A22 via the PVEMN line controls the amount of feedback and determines the emphasis or Q of the VCF. VCF ladder balance trim pot R166 is used to balance out offsets of FET follower Q14 and emphasis gain recovery amplifier A22.

Amplifier A19 serves as the main audio gain recovery amplifier. VCF level balance trim pot R162 is used to cancel any voltage offset of gain recovery amplifier A19. The output current of A19 is applied to current-to-voltage converter amplifier A20A which drives the direct VCF output via R168, C41 and the VCFO line. In addition, converter amplifier A20A drives output mixer amplifier A20B via R125.

The main gain recovery amplifier for VCF A19 is squelched whenever the VCF is turned off via diode CR25. Gain control of the VCF is accomplished by varying bias current to gain recovery amplifier A19 via resistor R181 and front panel MASTER GAIN VCF control R179.

The output mixer and swell circuits are comprised of Q15, Q16, PC1, A20B, T1 and associated components. The output mixer is a simple follower with a gain circuit summing the RES, VCF, DIRECT, MODE and AUX control input signals.

The composite voltage signal appearing at pin 5 of A20B is attenuated to a variable degree by the photoresistor contained in PC1. The resistance of this photocell is varied by the light intensity from the LED in PC1 which is in turn driven by a variable current source comprised of Q15, Q16 and associated components. If no signal is applied to the SWELL line, a bias voltage is applied to the base of emitter follower transistor Q15 via swell range trim pot R116 and divider resistors R117 and R118 such that current source transistor Q16 is just barely turned on. Swell range trim pot R116 is set so the signal level at pin 5 of A20B is attenuated 1dB below signal level when current source Q16 is turned fully off. If a voltage in the range of 0 to 5 volts is applied to the SWELL input, a variable current is passed to the LED in PC1 causing a variable attenuation of the signal level at the output of mixer amplifier A20B. Amplifier A20B drives 600 ohm output transformer T1 whose outputs are routed to rear panel XLR BAL MIX connector and a 1/4 inch phone jack.

Brightness control of the mother board modulators is accomplished via amplifier A3A and associated components. The output of A3A is 1.8 VDC when no current is injected on the PBRIN line, the brightness current control line from the front panel. Maximum brightness occurs when the output of A3A is -10 VDC.

6.2 GENERAL SERVICING

If the voltage controlled filter is completely dead, a simple audio tracing procedure can be used to locate the origin of difficulty. The audio signal (Refer to Volume II) enters on pins 2, 3 and 4 of 97, and via IC12, to gain recovery amplifier A20A and to coupling capacitor C35 either via IC13 or gate O_2 in IC12. The signal at C35 is a nominal 20mV maximum, so that observations must be made with a sensitive oscilloscope. An audio signal is injected into the transistor ladder at pin 2 of IC15 and exists from the transistor ladder on pins 7 and 10 of IC15 and connects to dual FET follower Q14. Low level audio may be viewed conveniently on Q14. The differential audio signal from Q14 is applied to gain recovery amplifier A19, filter output amplifier A20A and rear panel filter output and mix amplifier A20B. It is recommended that preset No. 8 be used with a key depressed to inject a signal into the voltage controlled filter. A determination of the components or part causing the problem can usually be accomplished by going through the above path and noting where loss of signal occurs.

Failures in individual circuit sections driving the filter should be located using the circuit schematic. The most sensitive components in these circuits are the CA3080s and CMOS ICs, namely: ICs 6 thru 8 and 11 thru 14. All CA3080s and CMOS ICs are plug in for easy replacement.

Difficulties with logic sections can usually be isolated by noting the appropriate output for related inputs to particular logic gates.

Should a power supply short occur, the difficulty (if it is a defective circuit element) can usually be noted by touching various ICs and transistors with the finger to see if they are warm.

NOTE

The power supply output voltages must be checked and adjusted if necessary (refer to Table 8-1) prior to all troubleshooting and alignment procedures and after replacement of all malfunctioning parts.

6.3 ALIGNMENT - POLYMOOG

All trim adjustments for the top right board (Figure 6-2) are available by removing the top cover.

Monitor external output with a DVM and MIX output with a scope, monitor, and an AC voltmeter. Turn rear panel SCALE pot full counterclockwise (viewed from the rear) and VCF MASTER GAIN full up.

6.3 ALIGNMENT - POLYMOOG (Continued)

a. KEYBOARD LOW ADJUST

1. Depress "VCF Keyboard Split/Lower." Repeatedly depress Eb$_2$ and adjust R100 for -167mV. Repeatedly depress F$_1$ and adjust rear panel scale for -2.00V.

2. Repeat step 1.

b. KEYBOARD HIGH ADJUST

1. Depress "VCF Keyboard All." Repeatedly depress E$_3$ and adjust R103 for -83 mV.

2. Repeatedly depress F$_6$ and adjust R36 for +3.00V. Repeat steps 1 and 2.

> **NOTE**
>
> Refer to paragraph 1.23, Section 1 of this manual for alignment procedures to match the Polymoog Synthesizer control voltage output to that of another synthesizer.

c. CONTOUR GENERATOR FEEDBACK ADJUSTMENT

1. Depress voltage controlled filter VAR pushbutton and position CONTOUR ATTACK and DECAY slide controls full up and SUSTAIN slide control full down.

2. Depress KEYBOARD ALL pushbutton and short pin 6 of IC5 (anode of CR16) to ground. Connect DVM to pin 6 of A12.

3. Depress a key and adjust trim pot R64 for a voltage indication of 11.0 ± 0.1 VDC. Disconnect short and voltmeter after settling to steady state.

d. MAXIMUM ATTACK AND DECAY ADJUSTMENT

1. Depress VCF VAR and position all VCF pots full down except ATTACK full up, EMPHASIS full up and CONTOUR AMT one half up.

2. Observe waveform at pin 6 of A12 and adjust trim pot R70 for an attack time of 10 ± 1 seconds or by timing with a watch and listening to the VCF output.

e. CONTOUR GENERATOR AMOUNT BALANCE ADJUSTMENT

1. Short pin 7 of P93 to ground and connect DVM to pin 6 of A13.

2. In preset No. 6 adjust trim pot R76 for a voltage indication of 0.0 ± 0.010 VDC with no keys depressed. Disconnect short and DVM.

f. KEYBOARD AMOUNT BALANCE ADJUSTMENT

1. Depress voltage controlled filter VAR pushbutton and position all slide controls full down.

2. Short pin 2 of A15 to ground and connect DVM to pin 6 of A21.

3. Adjust trim pot R172 so that voltage indication is the same within ± 0.005 VDC with KB slide control full up or full down. Disconnect short and voltmeter.

g. VCF RANGE

1. Depress VCF VAR and place all VCF controls at full down except place EMPHASIS full up.

2. Turn R161 full counterclockwise (clockwise if using blue or metal trim pots) and observe that the filter activates.

3. Adjust R80 so that oscillator frequency is 60 ± 2Hz.

h. VCF LADDER BALANCE

1. Depress VCF VAR and place all VCF sliders full down except place CUTOFF one half up and EMPHASIS full up.

2. Connect DVM to pin 1 of A20 and turn R161 until filter oscillates, then turn back until oscillator just barely dies out.

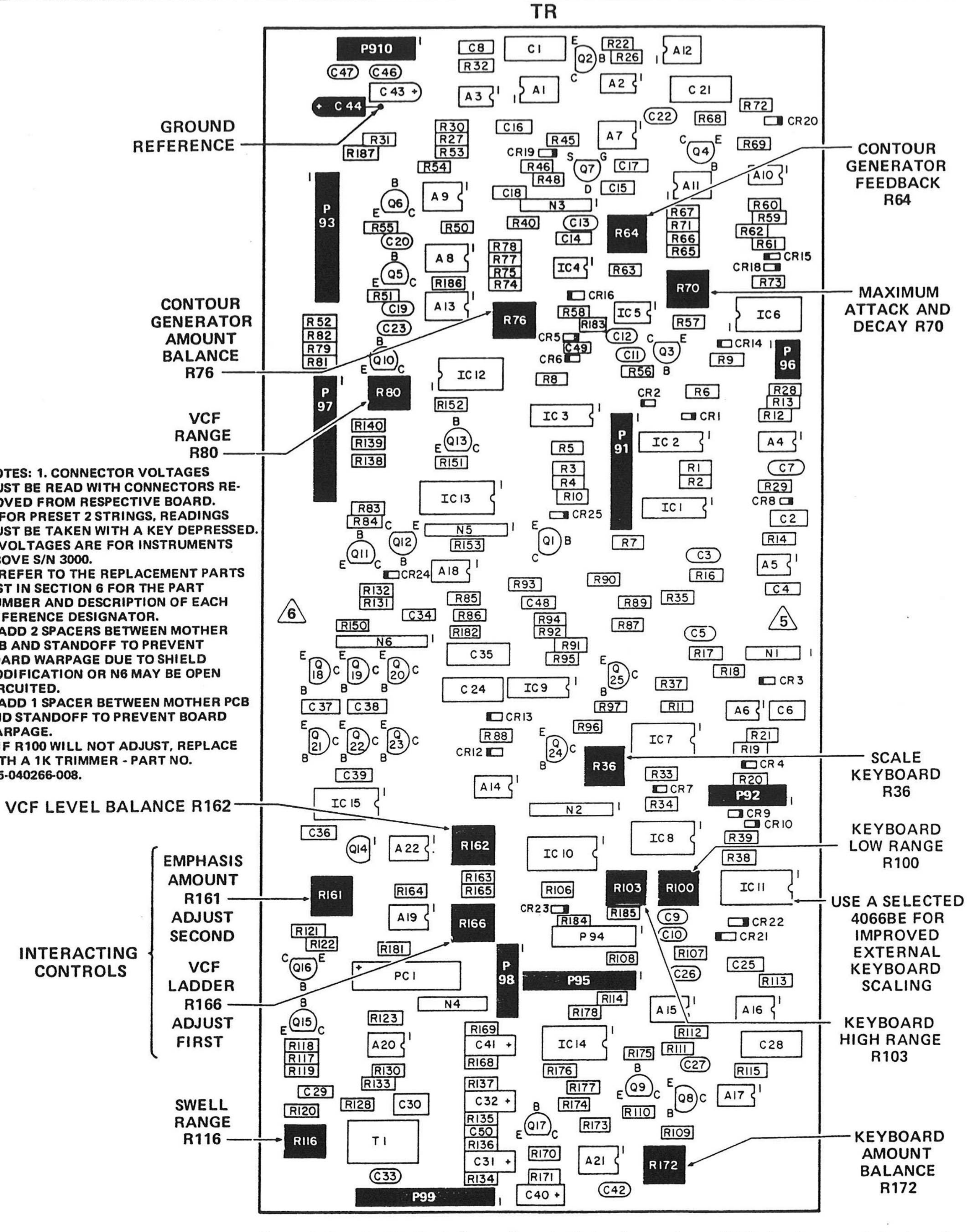
3. Adjust R166 so that the voltage indications anywhere between EMPHASIS full up and EMPHASIS full down are identical within 10 mV DC. Recheck VCF RANGE (step g).

i. EMPHASIS ADJUSTMENT (with dB meter)

1. Depress preset No. 8 and VCF VAR. Position all VCF sliders full down except position EMPHASIS full up. Monitor MIX output, raise VCF GAIN slider.

2. Adjust trim pot R161 until filter regenerates and adjust frequency of regeneration with front panel CUTOFF slider for 440Hz.

3. Raise DIRECT GAIN slider, depress A$_4$ (440Hz) and zero beat the sawtooth oscillator with the regeneration filter using the front panel fine tune. Return the DIRECT GAIN slider to 0.


TR
P910
P93
P97
P96
P91
P92
P94
P95
P98
P99
GROUND REFERENCE
CONTOUR GENERATOR FEEDBACK R64
MAXIMUM ATTACK AND DECAY R70
CONTOUR GENERATOR AMOUNT BALANCE R76
VCF RANGE R80
SCALE KEYBOARD R36
VCF LEVEL BALANCE R162
KEYBOARD LOW RANGE R100
EMPHASIS AMOUNT R161 ADJUST SECOND
INTERACTING CONTROLS
VCF LADDER R166 ADJUST FIRST
USE A SELECTED 4066BE FOR IMPROVED EXTERNAL KEYBOARD SCALING
KEYBOARD HIGH RANGE R103
SWELL RANGE R116
KEYBOARD AMOUNT BALANCE R172
R64
R70
R76
R80
R36
R162
R100
R103
R161
R166
R116
R172
6
5

NOTES: 1. CONNECTOR VOLTAGES MUST BE READ WITH CONNECTORS REMOVED FROM RESPECTIVE BOARD.
2. FOR PRESET 2 STRINGS, READINGS MUST BE TAKEN WITH A KEY DEPRESSED.
3. VOLTAGES ARE FOR INSTRUMENTS ABOVE S/N 3000.
4. REFER TO THE REPLACEMENT PARTS LIST IN SECTION 6 FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.
5. ADD 2 SPACERS BETWEEN MOTHER PCB AND STANDOFF TO PREVENT BOARD WARPAGE DUE TO SHIELD MODIFICATION OR N6 MAY BE OPEN CIRCUITED.
6. ADD 1 SPACER BETWEEN MOTHER PCB AND STANDOFF TO PREVENT BOARD WARPAGE.
7. IF R100 WILL NOT ADJUST, REPLACE WITH A 1K TRIMMER - PART NO. 925-040266-008.

Repeated on Inside Back Cover, Page 8-13, for Convenience While Performing Adjustments.

FIGURE 6-2 VOLTAGE CONTROLLED FILTER AND KEYBOARD CIRCUIT PRINTED CIRCUIT BOARD ASSEMBLY

4. Position filter EMPHASIS slider full down and note output level while holding A4 (A440) approximately -25 to -30dB).

5. Position filter EMPHASIS slider full up and adjust trimpot R161 for a 17dB increase over the level noted in step 4. Check each preset for no regeneration.

j. EMPHASIS AMOUNT ADJUSTMENT (without dB meter)

1. Perform VCF ladder balance and VCF level adjustment as directed in steps h and k.

2. Place EMPH slide control full up and all others full down. Monitor output with VCF GAIN, slider up and observe filter oscillation. Adjust trim pot R161 until the oscillator just barely dies out and disconnect oscilloscope.

k. VCF LEVEL BALANCE ADJUSTMENT

1. Perform VCF ladder balancing adjustment as directed in step h. Check that CUTOFF slider is at 5 and all other VCF sliders are at 0.

2. Connect a DVM to pin 1 of A20 and adjust R162 for +4.85V ± 10mV. Check alignment by moving CUTOFF slider fully down and then up. Note that DC output voltage does not vary more than 100mV from lowest to highest value. Recheck ladder balance (step h) and disconnect the oscilloscope and DVM.

l. SWELL RANGE ADJUSTMENT

1. Depress preset No. 8, place all OCTAVE BALANCE and DIRECT GAIN sliders full up.

2. Depress and hold A_4 and adjust R116 for maximum output.

3. Back off from that setting so that the output level drops 1dB (10 percent drop in amplitude).

6.4 REMOVAL

a. If it is necessary to remove a component, remove four screws at the center and left side of the board.

b. Raise board to gain bottom access noting it is hinged at the right side.

6.5 TROUBLESHOOTING

Troubleshoot the TR board using Table 6-1, the circuit description (paragraph 6-1), part location and schematic diagrams (Refer to Volume II). Note that voltage levels and waveforms displayed on the schematic diagram are not absolute values as readings may vary between units. Once the problem is localized, check the suspected part by direct substitution if possible. Otherwise use a voltmeter or oscilloscope to determine the malfunctioning part.

TABLE 6-1
POLYMOOG VOLTAGE CONTROLLED FILTER TR BOARD 9 TROUBLESHOOTING

PROBLEM	PROBABLE DEFECTIVE COMPONENT
KEYBOARD LOWER-UPPER switching does not operate properly	IC1, IC2, IC12
VCF ON-OFF does not operate properly	IC1, IC2, IC12, CR25
ALL-SPLIT mode inoperative	IC1, IC9, CR7, IC7
External foot sustain malfunction	IC3, IC2, CR20, Q1
FINAL DECAY LOCK-MAN malfunction	IC3, Q1
Trigger low works, trigger high inoperative	IC8

TABLE 6-1
POLYMOOG VOLTAGE CONTROLLED FILTER TR BOARD 9 TROUBLESHOOTING (Continued)

PROBLEM	PROBABLE DEFECTIVE COMPONENT
Trigger high works, trigger low inoperative	IC7
Trigger high and trigger low inoperative	IC7, A5, N1
DC trigger present but no AC trigger	A4, N1
String contour generator inoperative	A6, CR4
Modulation oscillator inoperative, no MODULATION S&H or AMT control	A2, Q2, A1*, A3B
MODULATION AMT but no S&H	A8*, Q5, Q7, A7*, C14, IC4, N3
No MODULATION AMT; have S&H	A9*, Q6
Contour generator operating properly but no CONTOUR AMT to VCF	A13*, Q10, trim pot R76 not adjusted properly
Contour generator dead but have trigger	IC5, IC6, A11*, A12, Q3, trim pot R64 not adjusted properly
Contour generator SUSTAIN level malfunction	A10, IC6, Q4, trim pot R70 not adjusted properly
Contour generator operating properly but no ATTACK or DECAY control	IC6, A10, Q4, trim pot R70 not adjusted properly
Single/multiple trigger malfunction	IC9, Q25, Q24
LOWER-UPPER keyboard scaling unequal	Adjust scale keyboard trim pot R36
Keyboard resistor string voltages incorrect	A14, IC10, CR23, N2, trim pots R100 and R103 not adjusted properly
Resistor string voltages correct, keyboard voltage does not change	IC11, A15, A16*, A17A, Q8
Keyboard voltage drifts	IC11, A15

*Replacement requires alignment.

TABLE 6-1
POLYMOOG VOLTAGE CONTROLLED FILTER TR BOARD 9 TROUBLESHOOTING (Continued)

PROBLEM	PROBABLE DEFECTIVE COMPONENT
Glide control does not operate properly	Q9, A16*
No filter CUTOFF frequency control	Q11, Q12, trim pot R80 not adjusted properly, N6
VCF audio path dead	IC12, A18, IC13, Q18, Q23, IC15, A14, A22*, A19*, A20A, N5, C41, trim pots, R161, R162 and R166 not adjusted properly
VCF ladder imbalance	Q18 thru Q23, Q14, A22*, A19*, IC15, trim pots R162 and R166 not adjusted properly
Variable frequency modulation AMT control sliders on front panel do not operate properly	A18B
SWELL control input malfunctions	Q15, Q16, trim pot R116 not adjusted properly, PC1, N4
DIRECT, VCF, MODE and AUX outputs operate properly but BAL MIX output dead	A20B, T1, PO2/SO2
CUTOFF frequency keyboard amount malfunction	A21*, Q17, IC14, trim pot R172 not adjusted properly *Replacement requires alignment.

TABLE 6-2
POLYMOOG VOLTAGE CONTROLLED FILTER AND KEYBOARD CIRCUIT PRINTED CIRCUIT TR BOARD 9 ASSEMBLY REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-040173-002	Voltage Controlled Filter and Keyboard Circuit Printed Circuit Board Assembly, consisting of:	
	906-040307-010	Socket, 10 Pin, SIL, AMP58377-3	1
A1,A7,A8,A9, A11,A13,A16, A19,A21,A22	991-041089-004	Integrated Circuit, LM3080AN	10
A2 thru A6, A10,A14,A17	991-041084-001	Integrated Circuit, Dual Operational Amplifier, LM358N.	8
A12,A15	991-041083-001	Integrated Circuit, CA3130	2
A18	991-041102-001	Integrated Circuit, Dual Operational Amplifier, MC1458CP-1	1
A20	991-041146-001	Integrated Circuit, Dual Operational Amplifier, 4558	1
1,C21,C24, C28	946-040229-105	Capacitor, Polyester, 1.0uf.	4
C2,C16	946-040229-682	Capacitor, Polyester, 0.0068uf	2

TABLE 6-2

POLYMOOG VOLTAGE CONTROLLED FILTER AND KEYBOARD CIRCUIT PRINTED CIRCUIT TR BOARD 9 ASSEMBLY REPLACEMENT PARTS LIST (Continued)

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
C3,C5,C9, C10,C13,C33, C46,C47,C49	947-040200-103	Capacitor, Disc, 0.01uf	9
C4	946-040229-223	Capacitor, Polyester, 0.022uf	1
C6,C8,C14, C29,C48,C50	946-040229-104	Capacitor, Polyester, 0.1uf.	6
C7,C19,C20, C22,C23,C27, C42	947-042020-501	Capacitor, Disc, 500pf	7
C11,C12	947-042020-102	Capacitor, Disc, 0.001uf	2
C15,C17,C36 thru C39	946-040229-103	Capacitor, Polyester, 0.01uf	6
C18	946-040229-473	Capacitor, Polyester, 0.047uf	1
C25,C30	946-040229-474	Capacitor, Polyester, 0.47uf	2
C26	947-042020-101	Capacitor, Disc, 100pf	1
C31,C32,C40, C41	945-040209-001	Capacitor, Aluminum, Electrolytic, 10uf, 25V	4
C34	946-040229-224	Capacitor, Polyester, 0.22uf	1
C35	946-040229-684	Capacitor, Polyester, 0.68uf	1
C43,C44	946-040231-002	Capacitor, Tantalum, 10uf, 20V	2
CR1,CR2,CR4 thru CR10, CR12 thru CR16,CR18, CR20,CR23, CR24	919-041075-001	Diode, 1N4148, Alternate 1N914	18
CR3,CR19, CR25	919-041074-001	Diode, 1N34A	3
CR21,CR22	919-042019-001	Diode, Rectifier, 1N4004	2
IC1	991-041092-001	Integrated Circuit, SN7400.	1
IC2,IC3,IC9	991-041096-001	Integrated Circuit, SN7426	3
IC4	991-042016-001	Integrated Circuit, MM5837N.	1
IC5	991-041107-001	Integrated Circuit, LM555	1
IC6,IC12	991-041087-001	Integrated Circuit, CMOS, CD4016AE	2
IC7,IC8,IC14	991-041086-001	Integrated Circuit, CMOS, CD4007AE	3
IC10	991-041108-001	Integrated Circuit, CA3183E	1
IC11	991-042597-001	Integrated Circuit, CMOS, CD4066BE	1
IC13	991-041090-001	Integrated Circuit, CMOS, CD4051AE	1
IC15	991-041104-001	Integrated Circuit, Transistor Array, CA3046	1
N1	949-040203-001	Resistor Network, Trigger Generator (R15,R23,R24,R25)*	1
N2	949-040204-001	Resistor Network, Keyboard Drive (R98,R99,R101,R102,R104, R105)*	1
N3	949-040205-001	Resistor Network, Sample and Hold (R41 thru R44, R47,R49)* . .	1
N4	949-040206-001	Resistor Network, Mixer (R124 thru R127,R129,R167)*	1
N5	949-040208-002	Resistor Network, Voltage Controlled Filter Preset (R141 thru R149)*	1
		* See Schematic Diagram for Resistor Values.	

TABLE 6-2

POLYMOOG VOLTAGE CONTROLLED FILTER AND KEYBOARD CIRCUIT PRINTED CIRCUIT TR BOARD 9 ASSEMBLY REPLACEMENT PARTS LIST (Continued)

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
N6	949-040207-001	Resistor Network, Voltage Controlled Filter (R154 thru R160)* . .	1
P91,P95	910-040301-009	Header, Printed Circuit, 9 Pin, (0.15 Centers), AMP640057-9	2
P92,P98	910-040301-006	Header, Printed Circuit, 6 Pin, (0.15 Centers), AMP640057-6	2
P93	910-040301-010	Header, Printed Circuit, 10 Pin, (0.15 Centers), AMP1-640057-0 . .	1
P94	910-040301-007	Header, Printed Circuit, 7 Pin, (0.15 Centers), AMP640057-7	1
P96	910-040301-003	Header, Printed Circuit, 3 Pin, (0.15 Centers), AMP640057-3	1
P97,P99	910-040301-011	Header, Printed Circuit, 11 Pin, (0.15 Centers), AMP1-640057-1 . .	2
P910	910-040306-007	Header, Printed Circuit, Keyed, 7 Pin, (0.15 Centers), AMP640245-1	1
PC1	948-041143-001	Relay, Optoelectric, Sigma 301T1-2A2.	1
Q1 thru Q6,Q9 thru Q11,Q16, Q17	991-041052-001	Transistor, PNP, 2N3906	11
Q7	991-041055-001	Transistor, Field Effect, Switching, E112	1
Q8,Q24	991-041053-001	Transistor, Darlington, D16P1	2
Q12,Q13,Q15	991-041051-001	Transistor, NPN, 2N3904	3
Q14	991-041054-001	Transistor, Field Effect, Dual, E402.	1
Q18 thru Q23, Q25	991-042017-001	Transistor, NPN, 2N3392	7
R1,R2,R6,R9, R27,R35,R39, R53,R57,R62, R75,R87,R91 thru R94,R186	852-312223-001	Resistor, 22K Ohm, ± 5%, 1/4W	17
R3,R28	852-312472-001	Resistor, 4.7K Ohm, ± 5%, 1/4W	2
R4,R54,R78, R122,R123, R183	852-312101-001	Resistor, 100 Ohm, ± 5%, 1/4W	6
R11,R21, R33,R51,R55, R82,R174	852-312102-001	Resistor, 1K Ohm, ± 5%, 1/4W	8
R7,R8,R89, R90	852-312822-001	Resistor, 8.2K Ohm, ± 5%, 1/4W.	4
R10,R66,R67	852-312681-001	Resistor, 680 Ohm, ± 5%, 1/4W	3
R12,R13,R17, R30,R34,R37, R38,R73,R81, R85,R86,R96, R97,R109, R112,R113, R131,R132, R136,R137, R169,R171, R175,R176, R177	852-312104-001	Resistor, 100K Ohm, ± 5%, 1/4W.	25
		* See Schematic Diagram for Resistor Values	

TABLE 6-2

POLYMOOG VOLTAGE CONTROLLED FILTER AND KEYBOARD CIRCUIT PRINTED CIRCUIT TR BOARD 9 ASSEMBLY REPLACEMENT PARTS LIST (Continued)

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
R14	852-312683-001	Resistor, 68K Ohm, ± 5%, 1/4W	1
R16,R29	852-312475-001	Resistor, 4.7 Megohm, ± 5%, 1/4W	2
R18,R20, R46,R111	852-312105-001	Resistor, 1 Megohm, ± 5%, 1/4W	4
R19	852-312565-001	Resistor, 5.6 Megohm, ± 5%, 1/4W	1
R22,R32,R50, R56,R69,R72, R74,R107, R108,R184, R185	852-312103-001	Resistor, 10K Ohm, ± 5%, 1/4W	11
R26,R115	852-512106-001	Resistor, 10 Megohm, ± 5%, 1/2W	2
R31	852-312753-001	Resistor, 75K Ohm, ± 5%, 1/4W	1
R36	925-040266-006	Resistor, Trim Pot, 2K Ohm	1
R40	852-312100-001	Resistor, 10 Ohm, ± 5%, 1/4W	1
R45,R59, R114,R153, R178	852-312273-001	Resistor, 27K Ohm, ± 5%, 1/4W	5
R48,R52,R65	852-312183-001	Resistor, 18K Ohm, ± 5%, 1/4W	3
R58,R63,R79, R95,R151, R152	852-312473-001	Resistor, 47K Ohm, ± 5%, 1/4W	6
R60	852-312363-001	Resistor, 36K Ohm, ± 5%, 1/4W	1
R61,R118, R182	852-312562-001	Resistor, 5.6K Ohm, ± 5%, 1/4W	3
R64,R166	925-040266-001	Resistor, Trim Pot, 10K Ohm	2
R68	852-312475-001	Resistor, 4.7 Megohm, ± 5%, 1/4W	1
R70	925-040275-005	Resistor, Trim Pot, 200K Ohm	1
R71	852-312164-001	Resistor, 160K Ohm, ± 5%, 1/4W.	1
R76,R80, R116,R172	925-040266-002	Resistor, Trim Pot, 100K Ohm	4
R77	852-312224-001	Resistor, 220K Ohm, ± 5%, 1/4W.	1
R83	852-312431-001	Resistor, 430 Ohm, ± 5%, 1/4W	1
R84,R130, R150,R181	852-312333-001	Resistor, 33K Ohm, ± 5%, 1/4W	4
R88	852-312510-001	Resistor, 51 Ohm, ± 5%, 1/4W	1
R100	925-040266-008	Resistor, Trim Pot, 1K Ohm	1
R103	925-040266-007	Resistor, Trim Pot, 500 Ohm	1
R106	853-422321-031	Resistor, 2.32K Ohm, ± 1%, 1/4W	1
R110	852-312184-001	Resistor, 180K Ohm, ± 5%, 1/4W	1
R117	852-312124-001	Resistor, 120K Ohm, ± 5%, 1/4W	1
R119	852-312244-001	Resistor, 240K Ohm, ± 5%, 1/4W	1
R120	852-312393-001	Resistor, 39K Ohm, ± 5%, 1/4W	1
R121	852-312432-001	Resistor, 4.3K Ohm, ± 5%, 1/4W.	1
R128	853-312392-001	Resistor, 3.9K Ohm, ± 5%, 1/4W.	1
R133	852-312200-001	Resistor, 20 Ohm, ± 5%, 1/4W	1

TABLE 6-2

POLYMOOG VOLTAGE CONTROLLED FILTER AND KEYBOARD CIRCUIT PRINTED CIRCUIT TR BOARD 9 ASSEMBLY REPLACEMENT PARTS LIST (Continued)

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
R134,R135, R168,R170	852-312561-001	Resistor, 560 Ohm, ±5%, 1/4W	4
R138,R139, R140	852-312203-001	Resistor, 20K Ohm, ±5%, 1/4W	3
R161	925-040266-008	Resistor, Trim Pot, 1K Ohm	1
R162	925-040266-004	Resistor, Trim Pot, 100 Ohm	1
R163,R165	852-312563-001	Resistor, 56K Ohm, ±5%, 1/4W	2
R164	852-312470-001	Resistor, 47 Ohm, ±5%, 1/4W	1
R173	852-312275-001	Resistor, 2.7 Megohm, ±5%, 1/4W	1
R187	852-312272-001	Resistor, 2.7K Ohm, ±5%, 1/4W	1
T1	954-041961-001	Transformer, LM9001	1
	906-042012-008	Socket, Integrated Circuit, DIP, 8 Pin, AMP583640-1	12
	906-040307-007	Socket, Integrated Circuit, Silicon, 7 Pin, AMP1-583773-4	14
	906-040307-008	Socket Integrated Circuit, Silicon, 8 Pin, AMP1-583773-5	4

6.6 POLYMOOG KEYBOARD PROGRAM CONTROL CIRCUIT DESCRIPTION (BOARD 9)

The Program Control board consists of the following major functional blocks:

a. Provides all preset control currents and logic levels to board 7. (Reference and Modulation Oscillator Waveshape and Keyboard Control.)

b. Single and multiple trigger circuits.

c. Keyboard circuit.

d. Contour generator.

IC1 and IC2 are bilateral 8 line to 1 line multiplexers which decode the binary information, from the MASTER VOICE SELECTOR (board 12), applied to their A, B and C inputs. Also from board 12 are the D and $\overline{D}$ lines which are inverted and level translated by IC3 A and B and applied to the INH inputs of IC1 and IC2. These lines alternately switch high and low to determine whether IC1 or IC2 is "on". For presets 1 through 7, IC1 will be active (its INH input low) and for presets 8 through 14, IC2 will be active (its INH input low).

NOTE

For complete binary coded information associated with each preset, see the TRUTH TABLE 7-8 in the MASTER VOICE SELECTOR (board 12) circuit description.

When a preset is selected it causes one of 50K ohm resistors, R6 through R19, to be connected to the resistor divider comprised of R4 and R5. This connection results in a precise potential of 10.0 VDC at the top of the 50K ohm resistor. This voltage is buffered by one of the amplifiers A1A through A7B, driving P-lines P1 through P14, which drive the preset resistor networks. N3 through N54 will be active and the value of the active resistor determines the magnitude of the current. We now have a means of supplying a specific current for each preset to the instrument program control inputs.

6.7 MODULATION RATE PROGRAMMING

Networks N3 through N8 provide the preset rate control of the pulse width modulation, frequency modulation 1, and frequency modulation 2. The output control current from these networks is fed through bilateral switch IC6, sections A, B and C to connector P94 and finally to the modulation control inputs of board 7.

The MODULATION VAR PRE latch on the LEFT HAND CONTROL board supplies a logic control to P99-1 which will be high (logical 1) for its VAR state and low (logical 0) for its PRE state. This logic signal is applied to gate IC10A (which inverts and level translates) whose output drives the control inputs of IC6 A, B and C through R26 and R27. For all presets when the MODULATION latch is in the PRE state, IC6 A, B and C will be on. Therefore, preset modulation networks N3 through N8 are active. For all presets except 2, 3 and 7, when the MODULATION latch is in the VAR state, IC6 A, B and C will be off. Therefore, preset modulation networks N3 through N8 will be inactive. In presets 2 and 3, CR2 and CR3 will be pulled up to +10VDC by P2 and P3. Therefore, IC6 A, B and C will be forced to the on condition regardless of the state of the MODULATION latch and N3 through N8 will remain active. IC6A preset 7 CR1 will be pulled up to +10VDC by P7. Therefore, IC6A only will be forced to the on condition regardless of the state of the MODULATION latch and N3 and N4 will remain active. IC6 B and C will still be switched off when the MODULATION latch is in the VAR state and N5 through N8 will be inactive. Resistors R26 and R27 provide isolation for the IC10A output through CR1, CR2 and CR3.

IC4 and IC5 switching is accomplished in the same manner as described for IC1 and IC2 except their INH lines are also gated with the previously described logic level from the MODULATION latch. Therefore, with the MODULATION latch in the PRE state, both IC4 and IC5 will be off. In the VAR state, either IC4 or IC5 will be on depending on the preset selected (presets 1 through 7, IC4, and presets 8 through 14, IC5 will be on). Assuming that the MODULATION latch is in the VAR state, one of the output pins of IC4 or IC5 will be connected to the front panel MOD RATE potentiometer R106 through R23. Resistor R22 determines the minimum current and R23 determines the maximum current to be supplied to a control input. There is now a method, as determined by the ouput connection arrangement of IC4 and IC5, to select which one of the three modulators will be controllable by R106 in the VAR state of the MODULATION latch.

6.8 MODULATION AMOUNT PROGRAMMING

Networks N9 through N16 provide the preset amount control of the pulse width modulation low, pulse width modulation high, frequency modulation 1, and frequency modulation 2. The output control current from these networks is fed through bilateral switch IC9, sections A through D, to connector P94 and finally to the modulation control inputs of board 7.

The IC9 switching, as controlled by the MODULATION latch on the LEFT HAND CONTROL board, is the same as the switching described in the MODULATION RATE programming paragraph of this section for IC6 A, B and C except that the only preset that overrides the off state for one of the IC9 sections (MODULATION latch in the VAR state) is preset 7. With preset 7 selected, CR4 will be pulled up to +10VDC by P7 which will force IC9 B and D to the ON state regardless of the state of the MODULATION latch and N13 through N16 will remain active. Sections A and C of IC9 will still be switched by the action of the MODULATION latch.

The switching of IC7 and IC8 is exactly the same as the switching of IC4 and IC5 as described in the MODULATION RATE programming paragraphs of this section. With the MODULATION latch in the VAR state, it will connect one output of either IC7 or IC8 to the wiper of the front panel MOD AMT potentiometer R108. The top of potentiometer R108 is driven by amplifier A8A whose output is nominally at +10VDC. Rear panel MOD AMT jack J1 has been provided so a foot pedal may be used to attenuate the output potential of A8A, thereby having foot control of the modulation amount. Resistors R32 through R54 determine the maximum modulation amount control current. Their connection arrangement determines which modulation amounts will be controlled by the front panel MOD AMT potentiometer R108 in the VAR state of the MODULATION latch.

The Modulation Table 6-3 that follows will help to summarize the programming of modulation rates and amounts in variable and preset.

TABLE 6-3 MODULATION

		MODULATION RATE			MODULATION AMOUNT			
PRESET	**MOD LATCH**	**PWM**	**FM1**	**FM2**	**PWM LOW**	**PWM HIGH**	**FM1**	**FM2**
1-14	P	PR	PR	PR	PR	PR	PR	PR
1	V	N	N	VAR	N	N	VAR	N
2	V	PR	PR	PR	VAR	VAR	VAR	VAR
3	V	PR	PR	PR	VAR	VAR	VAR	VAR
4	V	N	N	VAR	N	N	N	VAR
5	V	N	VAR	N	N	N	VAR	N
6	V	N	N	VAR	N	N	VAR	N
7	V	PR	N	VAR	N	N	PR	1*
8	V	N	N	VAR	N	N	N	VAR
9	V	N	VAR	N	N	N	VAR	N
10	V	N	N	VAR	N	N	N	VAR
11	V	N	N	VAR	N	N	N	VAR
12	V	VAR	N	N	VAR	VAR	N	N
13	V	N	N	VAR	N	N	N	VAR
14	V	N	VAR	N	N	N	VAR	N

LEGEND

P — PRE state of latch.

V — VAR state of latch.

N — No variable or preset control current.

PR — Internal programming remains active and potentiometers have no control.

VAR — Modulation controlled by RATE or AMT potentiometer.

PWM — Pulse width modulation.

FM1 — Frequency modulation 1.

FM2 — Frequency modulation 2.

NOTE

1. *Modulation control current is the sum of the preset current and the current supplied by the MOD AMT potentiometer.
2. In cases where modulation rates have no control current (N), the modulation oscillator on board 7 will still run at its minimum rate.

6.9 LOUDNESS ATTACK PROGRAMMING

Networks N53 and N54 provide preset control of the loudness attack. The output control current from these networks is fed through bilateral switch IC11A to connector P910 and finally to the loudness attack control input of board 7.

The ATTACK VAR PRE latch on the LEFT HAND CONTROL board supplies a logic control to P94-4 which will be high (logical 1) for its PRE state and low (logical 0) for its VAR state. This logic signal is applied to the control of IC11A. Therefore, IC11A will be off, making N53 and N54 inactive for its VAR state. This ATTACK latch logic level is also applied to IC11C which is used as an inverter and drives IC11B. Thus the IC11B on/off function will be the opposite of IC11A.

The variable state of the loudness attack function has a programmed maximum control current. The variable attack networks N51 and N52 determine this maximum current and are similar to the preset networks but, rather than driving a control input directly, drive A11 A and B. This proportionately changes the output current from N51 and N52 to a voltage to drive the top of the ATTACK potentiometer R109B. The wiper of R109B is tied through R92 to the input of IC11B which, in its on state (VAR state of the ATTACK latch), supplies control current to the loudness control input of board 7.

6.10 FOOT SUSTAIN PROGRAMMING

FOOT SUSTAIN is programmed on for presets 1, 2, 9, 10, 11 and 12 by networks N49 and N50. The resistor in those locations forces current to flow through the base emitter junction of Q5, causing Q5 to pull up the emitter of Q6, forward biasing it and pulling the FTSUB lines of each of the MOTHER BOARD to ground, which turns on the FOOT SUSTAIN. Remaining presets have no resistors programmed, therefore the FTSUB lines stay at -5.5VDC and the FOOT SUSTAIN is off. Rear panel FOOT SUSTAIN jack J2 has been provided to allow the usage of a foot switch to turn the FOOT SUSTAIN on where it is not programmed on.

6.11 MISCELLANEOUS PROGRAMMING

Networks N27 through N48 have no switching associated with them and drive their respective control inputs of board 7.

Networks N19 through N26 are used to drive logic signals to program various switching functions. Whenever a resistor is preset in a network, selecting the associated preset will turn on the output transistor Q1 through Q4, causing its collector to go to ground (logical 0). If no resistor is programmed, the collector will be high (logical 1). Networks N21 through N26 have an extra inversion provided by IC10B, C and D. Assuming a resistor is programmed for a selected preset, the state of the following switching function will be: LOCK/FREE; FREE; FOOTAGE - 16′; FOOTAGE - 4′; ON/OFF, OFF.

The BRIGHTNESS NETWORKS N17 and N18, rather than having a current output, is converted to a voltage drive by summing amplifier A9B. Resistor R55 provides a required offset at the A9B output.

6.12 TRIGGER CIRCUIT

Whenever a key is depressed, a current of approximately 4 microamps is applied to the TRGB line (trigger buss line) from the keyboard. This current is routed to the input of trigger summing amplifier A10A which generates a negative step of approximately 200 millivolts for each key depressed. R65 and C7 filter out unwanted 20kHz which is present on the keyboard and picked up by the TRGB line. C6 rolls off the gain of A10A at high frequencies. The output of A10A drives comparator A10B, whose threshold is approximately 200 millivolts below the zero trigger signal (no keys depressed) output of reference A10A. Depression of one or more keys causes the output of A10B to swing from -15 to about +3.5VDC. This A10B single trigger output is applied to the base of Q7 by R66. The output of trigger summing amplifier A10A is also coupled via C8 to multiple trigger generator A9A. The positive input of A9A is biased to the -5.5VDC rail via R72. The negative input reference is approximately 200 millivolts more negative, derived from resistors R68 and R71. Each time a key is depressed, a step on A10A causes a 5 millisecond negative going pulse on A9A. A small amount of regeneration providing Schmitt trigger action is accomplished by R73 and C9. The multiple trigger output of A9A drives the base of Q7, which is the S-TRIGGER output and will be at +15VDC (trigger off). When a key is depressed, the A10B single trigger output goes high, turning Q7 on and pulling its collector to ground (trigger on). If a second key is depressed, while holding the first, multiple trigger amplifier A9A fires negative for 5 milliseconds, and sinks all the current that was supplied to Q7 by A10B. The collector of Q7 will return positive during this time, which is a momentary loss of trigger, and then returns to ground which is a new or multiple trigger. Subsequent keys depressed will cause this action to repeat. When all keys have been released, the Q7 collector returns positive and the trigger is off. Rear panel switch SW1 and jack J3 (for foot switch control) provide switching between the single and multiple trigger modes. With SW1 in the open position, the circuit functions as described above and multiple triggering is the result. Sliding SW1 to the closed position shunts the multiple trigger output of A9A to ground, causing single triggering.

NOTE

In order for a trigger foot switch installed in J3 to function, SW1 must be in the MULTIPLE position.

6.13 KEYBOARD CIRCUIT

The keyboard circuit consists of the following functional blocks:

1) Current source.

2) Sample and hold.

3) Glide circuit.

The keyboard assembly has a monophonic section which is a resistor string consisting of seventy-one 100 ohm resistors in series and a normally open switch contact between the junction of each resistor in the string and a common buss bar. When a key is depressed, a contact connects a point on the resistor string to the buss.

A12B, in conjunction with R81, R83 and the keyboard resistor string form a differential amplifier whose differential inputs are tied together at R110. Since the keyboard resistor string is in the feedback loop, it will be driven by a constant current. Rear panel KEYBOARD SCALE potentiometer R110 adjusts this constant current from a nominal 833 microamps, ± 10 percent. Since R110 moves both differential inputs together (the differential input will always be zero), R81 is equal to R82 and the total resistance of the keyboard resistor string is equal to R83 (seventy-one 100 ohm resistors in series and is very close to the value of R83), provided no keys or only one key is depressed, the output of A12B will always be 0.0VDC regardless of the setting of R110. If more than one key is depressed, the resistors in the string between the depressed keys will be shorted out, reducing the resistor string total resistance. The voltage at the top of the resistor string now remains constant. However, the output of A12B will increase to maintain the set current.

Assuming the SCALE potentiometer was set to drive the nominal current of 833 microamps through the resistor string, the voltage delivered to the buss by the switch contacts, due to the IR drops of the 100 ohm resistors, would rise from 0.0VDC (lowest note) at a rate of 83.3 millivolts per semitone, or 1 volt per octave. Since the SCALE potentiometer can change this current ± 10 percent, this voltage rise would also change ±10 percent.

The keyboard buss voltage is applied to holding capacitor C10 and buffer A12A through bilateral switch IC11D and R88. When a key is depressed, multiple trigger amplifier A9 (described in the Trigger Circuit paragraph in this section) fires a 5 millisecond negative going pulse which is inverted by Q8 and turns IC11D on. Holding capacitor C10 charges through R88, which limits current slugs, to the buss voltage and A12A buffers it to avoid loading of C10. The keyboard buss voltage is now stored at the A12A output. Since this holding circuit is triggered by a multiple trigger, every time an additional note is depressed, a new sample will result. However, because the keyboard circuit has high note priority, only successively higher notes depressed will cause a change in keyboard control voltage at the A12A output. R85 and R86 offset the output of A12A by -83 millivolts or down one semitone. This makes the lowest F on the keyboard 0.0VDC which is compatible to other MOOG products. R87 is in series with the A12A output to prevent oscillations that might result when driving fairly high cable capacitances. Rear panel KEYBOARD RANGE potentiometer R111 through R84 allows an adjustment of ± 1 semitone to compensate for internal and slave unit offsets. The A23A output drives the VCF on board 8 directly and one end of the rear panel GLIDE potentiometer R112.

The glide time will be exponential as determined by the time constant formed by the GLIDE potentiometer R112 and capacitor C12. Buffer A13 drives the KBD, C.V. OUT jack J4 through R90 which isolates the A13 output from cable capacitance which could cause oscillations. C11 rolls off the high frequency gain of A13 to further reduce the possibility of oscillation. Note that the glide circuit is after the sample and hold circuit therefore the keyboard control voltage will continue to glide up or down until it reaches the last control voltage sampled, after all keys have been released. GLIDE ON/OFF jack J5 has also been provided to allow foot switch control of glide.

6.14 FILTER CONTOUR GENERATOR

The filter contour generator for Polymoog Keyboard is used to generate a contour which modifies the cutoff frequency of the voltage control and filter for preset voices 9 and 10, the brass voices.

The filter contour generator is triggered by the S-trigger appearing at the collective of Q7. Either single or multiple triggering of this contour generator is controlled by the operating mode of the S-trigger signal itself. The S-trigger signal is differentiated by C13 and R94 and coupled to the gate of the buffer FET Q13 via R95. R95 is sufficiently large to pre-[illegible] damage to A13 on positive transistions of the S-trigger signal. The contour signal itself appears at the positive side of the integrating capacitor C14. Assume for circuit description purposes that this contour signal is initially at 0VDC. The negative going transition applied to the gate of Q13 causes the potential on pins 3, 13 and 10 of IC12 to go to +15VDC. This in turn causes Q11 to be turned on which pulls down the voltage on pins 5 and 6 of IC12. This causes Q10 to be turned on, latching the potential on pins 3, 13 and 10 of IC12 to +15V. Thus, Q10 and Q11 form a complimentary type latch. The S-trigger signal appearing on the collector of Q7 is directly coupled to the gates of Q14 and Q16 in IC13 and as long as a note is held depressed, sistor Q16 is turned off and transistor Q14 is rned on. In general, this contour generator works by switching in various sources of current during the attack, sustain and decay phases.

Attack current is provided through one of the latch transistors in IC12, namely Q11. As previously noted, during initial depression of a key, Q11 is turned on. After initial triggering, the voltage on pins 3, 13 and 10 and IC12 is +15VDC, which turns on Q12. This pulls the voltage applied to pin 10 of IC13 to 0VDC and holds the decay path transistor Q15 off. During the attack phase, current supplied via pins 5 and 6 of IC12 and Q11 in IC12 causes the potential on the integration capacitor C14 to begin to rise linearly. This voltage continues to rise until transistor Q11 turns off because of back gate bias effects which occur approximately at a potential to 7-1/2V. The attack current applied to pins 5 and 6 of IC12 is derived either from the preset values determined in resistor networks N53 and N54 or from the variable attack control circuit to be described later.

When the attack source transistor Q11 cuts off, the potential on the gate of Q10 goes to +15V which turns off Q10, causing the voltage on pins 3, 13 and 10 of IC12 to return to 0VDC. This turns the inverting transistor Q12 off and causes the potential applied to pin 10 of IC18 to go to +15VDC which turns on the decay path transistor Q15. If a note is still depressed, then, as mentioned previously, the sustain level transistor Q14 is turned on. This applies a potential, determined by the resistor divider network consisting of R102 and R103, to be applied to the decay resistor R104 through Q14 and Q15. This is the decay toward sustain level with a note held depressed. Note that the voltage on the integration capacitor C14 will then approach the sustain level with a time constant determined by the resistor R104 and the integration capacitor C14. When all notes are released, the S-trigger signal on the collector of Q7 returns to +15VDC which turns off the sustain level transistor Q14 and turns on the final decay level transistor A16 in IC13. Now the voltage on the integration capacitor C14 starts toward 0VDC with a time constant determined by R104 and C14. This final decay path is accomplished through Q15 and Q16.

It is interesting to note that transistors Q10 and Q11 in IC12 serve as a combined latch/comparator. This latch is turned on when a note is depressed and stays on until the voltage across the integration capacitor C14 has reached its maximum level, turning off transistor Q11. In summary, the attack current is supplied via Q11, the decay toward sustain level current is supplied via Q14 and Q15, and the decay toward the final sustain level (namely 0VDC) is accomplished through Q15 and Q16.

The attack mode current applied to pins 5 and 6 of IC12 is derived either from the preprogrammed attack supplied through R96 and the analog gate, IC6D, or from the collector of Q9 and diode CR5. If the attack control mode is preset, then the current is supplied via IC6D because the control line applied to pin 6 of IC6D is at +15VDC, turning on the gate and turning off the current source transistor Q9. When the attack control mode is in variable, the potential applied to pin 6 on IC6D is at 0VDC. This turns off the gate and applies a drive voltage to the base of Q9 which allows current to flow via the front pan attack potentiometer R109A through R99 (th minimum attack time resistor), Q9 and CR5 to pir 5 and 6 of IC12.

6.15 TROUBLESHOOTING

Troubleshoot the program control TR9 boar circuit using Table 6-4, the circuit description (para graph 6.6) and part location and schematic diagram in Volume II.

TABLE 6-4
POLYMOOG KEYBOARD PROGRAM CONTROL TR BOARD 9 TROUBLESHOOTING

PROBLEM	PROBABLE DEFECTIVE COMPONENT
Preset pulse width modulation rate defective	IC6B, N3, N4
Preset pulse width modulation amount high	IC9A, N9, N10
Preset pulse width modulation amount low	IC9C, N11, N12
Preset frequency modulation 2 rate defective	IC6A, N5, N6
Preset frequency modulation 2 amount defective	IC9D, N13, N14
Preset frequency modulation 1 rate defective	IC6C, N7, N8
Preset frequency modulation 1 amount defective	IC9B, N15, N16
VAR (Modulation controlled by RATE potentiometer) pulse width modulation RATE defective	IC5, R106 (Front Panel)
VAR (modulation controlled by RATE potentiometer) frequency modulation 1 or 2 RATE defective	IC5, IC4, R106 (Front Panel)
Brightness of notes on entire keyboard defective	A9B, N17, N18

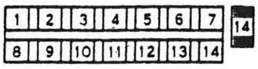


TABLE 6-4

POLYMOOG KEYBOARD PROGRAM CONTROL TR BOARD 9 TROUBLESHOOTING (Continued)

PROBLEM	PROBABLE DEFECTIVE COMPONENT
LOCK/FREE oscillator control not operative	Q1, N19, N20
⎍⎍ Footage defective	Q2, IC10D, N21, N22
◿◿◿ Footage defective	Q3, IC10C, N23, N24
⎍⎍ ON/OFF defective	Q4, IC10B, N26
Preset loudness attack defective	IC11A, N53, N54, IC13
VAR(Modulation controlled by RATE or AMT potentiometer) loudness ATTACK defective	IC12, CR5, Q9, IC6D, A11, IC11B, IC11C, N51, R109, A, B, IC13
◿◿◿ Level LOW defective	N29, N30
◿◿◿ Level HIGH defective	N31, N32
Drive Level Limit defective	N33, N34
Decay LOW defective	N35, N36
Decay HIGH defective	N37, N38
Dynamics defective	N39, N40
Sustain LEVEL defective	N41, N42
Pulse width LOW defective	N43, N44
Pulse width MEDIUM defective	N45, N46
Pulse width HIGH defective	N47, N48
Final SUSTAIN defective	N49, N50, Q5, Q6
External keyboard control voltage malfunctioning	Q8, IC11D, A12A, A13, A9, R12, (Rear Panel)
External keyboard control voltage will not scale	A12B, R110 (Rear Panel)
Any voice 1 through 7 defective	IC1, A1, A2, A3, A4A
Any voice 8 through 14 defective	IC2, A4B, A5, A6, A7

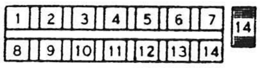


TABLE 6-5

POLYMOOG KEYBOARD PROGRAM CONTROL PRINTED CIRCUIT TR BOARD 9 ASSEMBLY
REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-042499-002	Program Control Printed Circuit Baord Assembly, consisting of:	
A1 thru A7	991-041084-001	Integrated Circuit, Dual Operational Amplifier, LM358N	7
A8 thru A11	991-041102-001	Integrated Circuit, Dual Operational Amplifier, MC1458CP-1	4
A12	991-042661-001	Integrated Circuit, Dual Operational Amplifier, TL082	1
A13	991-041951-001	Integrated Circuit, Operational Amplifier, LF356-N	1
C1 thru C3	946-040231-002	Capacitor, Tantalum, 10uf, 20V	3
C4,C7,C11	947-040200-103	Capacitor, Disc, 0.01uf	3
C5	946-040229-104	Capacitor, Polyester, 0.1uf.	1
C6	946-040229-682	Capacitor, Polyester, 0.0068uf	1
C8	946-040229-223	Capacitor, Polyester, 0.022uf	1
C9	947-042020-501	Capacitor, Disc, 500pf	1
C10,C12	946-040229-474	Capacitor, Polyester, 0.47uf	2
C13	946-040229-102	Capacitor, Polyester, 0.001uf	1
C14,C16	946-040231-003	Capacitor, Tantalum, 2.7uf, 35V.	2
C15	947-042020-501	Capacitor, Disc, 500pf	1
CR1 thru CR3, CR5	919-041075-001	Diode, 1N4148, Alternate 1N914	4
IC1,IC2,IC4, IC5,IC7,IC8	991-041090-001	Integrated Circuit, CMOS, CD4051AE	6
IC3,IC10	991-041096-001	Integrated Circuit, SN7426	2
IC6,IC9,IC11	991-041087-001	Integrated Circuit,CMOS, CD4016AE	3
IC12	991-041086-001	Integrated Circuit, CMOS, CD4007AE	1
IC13	991-041086-002	Integrated Circuit, CMOS, CD4007AE	1
N1	949-040319-001	Resistor Network, Reset Volt. Div. 1, (R4 thru R12, R19)*	1
N2	949-042664-001	Resistor Network, Reset Volt. Div. 2, (R13 thru R18)*	1
N3	949-042678-002	Resistor Network, PWM RATE 1, (R1 thru R3)*	1
N4	949-042679-001	Resistor Network, PWM RATE 2, (R4, R5, R7)*	1
N5	949-042680-002	Resistor Network, FM2, RATE 1, (R1,R2,R3,R7)*	1
N6	949-042681-002	Resistor Network, FM2, RATE 2, (R3,R7)*	1
N7	949-042823-001	Resistor Network, FM1, RATE 1, (R1 thru R3)*	1
N8	949-042682-001	Resistor Network, FM1, RATE 2	1
N9	949-042683-002	Resistor Network, PWM AMT. HIGH 1, (R1,R2,R3,R7)*	1
N10	949-042684-002	Resistor Network, PWM AMT, HIGH 2, (R1,R4,R7)*	1
N11	949-042685-002	Resistor Network, PWM AMT, LOW 1, (R1,R2,R3,R7)*	1
N12	949-042686-002	Resistor Network, PWM AMT. LOW 2, (R1,R5,R7)*	1
N13	949-042687-002	Resistor Network, FM2 AMT. 1, (R1,R2,R3,R7)*	1
N14	949-042688-002	Resistor Network, FM2 AMT. 2, (R2,R3,R6,R7)*	1
N15	949-042689-002	Resistor Network, FM1 AMT. 1 (R1 thru R3)*	1
N16	949-042690-001	Resistor Network, FM1 AMT. 2	1
N17	949-042691-002	Resistor Network, Brightness 1, (R2 thru R7)*	1
N18	949-042692-001	Resistor Network, Brightness 2, (R1 thru R7)*	1
N19	949-042693-001	Resistor Network, LOCK/FREE 1, (R1,R2,R3,R6)*	1
		* See Schematic Diagram for Resistor Values (± 5%, 1/4W)	

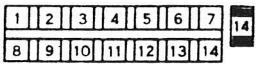


TABLE 6-5
POLYMOOG KEYBOARD PROGRAM CONTROL PRINTED CIRCUIT TR BOARD 9 ASSEMBLY REPLACEMENT PARTS LIST
(Continued)

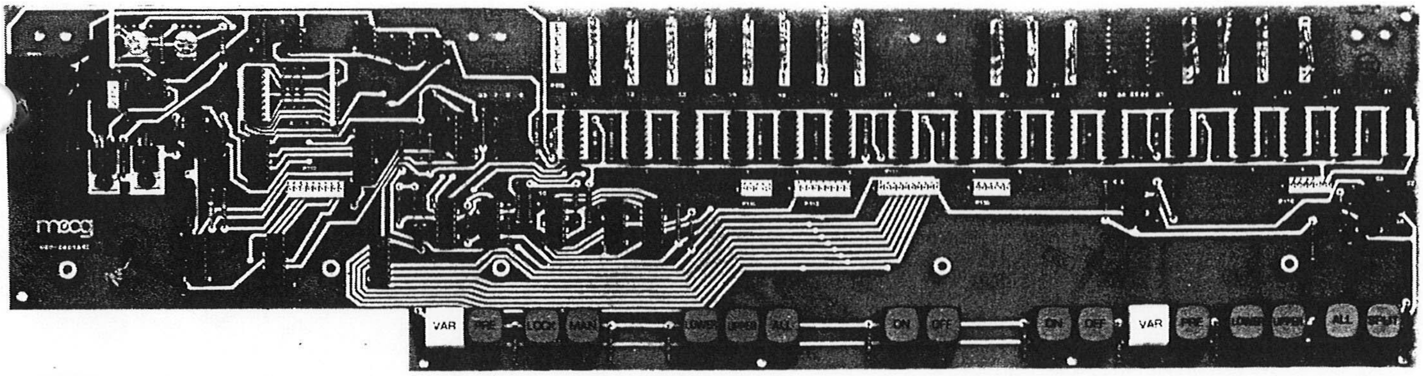
INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
N20	949-042694-002	Resistor Network, LOCK/FREE 2, (R6)*	1
N21	949-042695-001	Resistor Network, ⎍⎍ FOOTAGE 1	1
N22	949-042696-001	Resistor Network, ⎍⎍ FOOTAGE 2, (R4,R5)*	1
N23	949-042697-001	Resistor Network, /|/| FOOTAGE 1, (R5,R7)*	1
N24	949-042698-001	Resistor Network, /|/| FOOTAGE 2, (R1,R4,R5)*	1
N25	949-042699-001	Resistor Network, ⎍⎍ ON/OFF 1	1
N26	949-042700-001	Resistor Network, ⎍⎍ ON/OFF 2,(R2)*	1
N27	949-042701-002	Resistor Network, Detune 1, (R6)*	1
N28	949-042702-001	Resistor Network, Detune 2	1
N29	949-042703-002	Resistor Network, Saw Level Low 1, (R1 thru R7)*	1
N30	949-042704-001	Resistor Network, Saw Level Low 2, (R1 thru R5,R7)*	1
N31	949-042705-002	Resistor Network, Saw Level High 1, (R1 thru R7)*	1
N32	949-042704-001	Resistor Network, Saw Level High 2, (R1 thru R6)*	1
N33	949-042706-001	Resistor Network, Drive Level Limit 1, (R1 thru R7)*	1
N34	949-042707-002	Resistor Network, Drive Level Limit 2, (R1 thru R5,R7)*	1
N35	949-042708-002	Resistor Network, DECAY LOW 1, (R1 thru R7)*	1
N36	949-042709-002	Resistor Network, DECAY LOW 2, (R1 thru R7)*	1
N37	949-042708-002	Resistor Network, DECAY HIGH 1, (R1 thru R7)*	1
N38	949-042709-002	Resistor Network, DECAY HIGH 2, (R1 thru R7)*	1
N39	949-042710-002	Resistor Network, Dynamics 1, (R2, R3 thru R7)*	1
N40	949-042711-002	Resistor Network, Dynamics 2, (R1 thru R3, R6,R7)*	1
N41	949-042712-003	Resistor Network, SUSTAIN 1, (R1,R2,R3)*	1
N42	949-042713-002	Resistor Network, SUSTAIN 2, (R2 thru R5,R7)*	1
N43	949-042714-002	Resistor Network, PW LOW 1, (R1 thru R7)*	1
N44	949-042715-001	Resistor Network, PW LOW 2, (R1,R3 thru R7)*	1
N45	949-042716-001	Resistor Network, PW MED. 1, (R1 thru R7)*	1
N46	949-042717-001	Resistor Network, PW MED. 2, (R1, R3 thru R7)*	1
N47	949-042716-002	Resistor Network, PW HIGH 1, (R1 thru R7)*	1
N48	949-042717-001	Resistor Network, PW HIGH 2, (R1,R3 thru R7)*	1
N49	949-042718-001	Resistor Network, Preset 1-7, (R1,R2)*	1
N51	949-042720-001	Resistor Network, VAR LOUD ATTACK 1, (R1,R2,R3)*	1
N52	949-042721-001	Resistor Network, VAR LOUD ATTACK 2, (R2,R3, R4)*	1
N53	949-042722-002	Resistor Network, LOUD ATTACK 1, (R1,R2,R3)*	1
N54	949-042723-002	Resistor Network, LOUD ATTACK 2, (R2,R3,R4)*	1
P91	910-040303-005	Header, Printed Circuit, Keyed, 5 Pin, (0.150 Centers), AMP640242-5	1
P92,P93,P95	910-040301-006	Header, Printed Circuit, 6 Pin, (0.150 Centers), AMP640057-6	3
P94,P99,P910	910-040301-010	Header, Printed Circuit, 10 Pin, (0.150 Centers), AMP1-640057-0	3
P96,P97	910-040301-007	Header, Printed Circuit, 7 Pin, (0.150 Centers), AMP640057-7	2
		* See Schematic Diagram for Resistor Values (± 5%, 1/4W)	

TABLE 6-5
POLYMOOG KEYBOARD PROGRAM CONTROL PRINTED CIRCUIT TR BOARD 9 ASSEMBLY REPLACEMENT PARTS LIST
(Continued)

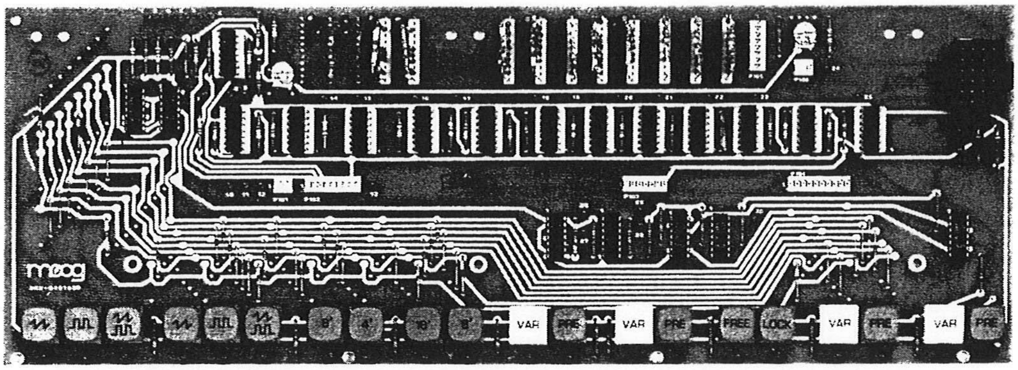
INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
P98	910-040301-008	Header, Printed Circuit, 8 Pin, (0.150 Centers), AMP640057-8	1
Q1 thru Q5, Q7,Q8,Q17	991-041051-001	Transistor, NPN, 2N3904	8
Q6,Q9	991-041052-001	Transistor, PNP, 2N3906	2
R1,R2,R3, R20,R21,R27	852-312223-001	Resistor, 22K Ohm, ± 5%, 1/4W	6
R22	852-312824-001	Resistor, 820K Ohm, ± 5%, 1/4W	1
R23	852-312204-001	Resistor, 200K Ohm, ± 5%, 1/4W	1
R24,R25,R28 thru R31,R46, R54,R68,R72, 77 thru R79, R89,R91,R93, R100,R101, R113	852-312104-001	Resistor, 100K Ohm, ± 5%, 1/4W	19
R26,R53,R94, R95	852-312105-001	Resistor, 1 Megohm, ± 5%, 1/4W	4
R32,R34,R35, R38,R42	852-312183-001	Resistor, 18K Ohm, ± 5%, 1/4W	5
R33,R36,R37, R39 thru R41, R96	852-512153-001	Resistor, 15K Ohm, ± 5%, 1/4W	7
R43	852-312563-001	Resistor, 56K Ohm, ± 5%, 1/4W	1
R44,R47, R80,R92	852-312473-001	Resistor, 47K Ohm, ± 5%, 1/4W	4
R45,R104	852-312513-001	Resistor, 51K Ohm, ± 5%, 1/4W	2
R48	852-312393-001	Resistor, 39K Ohm, ± 5%, 1/4W	1
R49	852-312363-001	Resistor, 36K Ohm, ± 5%, 1/4W	1
R50,R55	852-312753-001	Resistor, 75K Ohm, ± 5%, 1/4W	2
R51,R52	852-312103-001	Resistor, 10K Ohm, ± 5%, 1/4W	2
R56,R65 thru R67,R69,R70, R86	852-312103-001	Resistor, 10K Ohm, ± 5%, 1/4W	7
R57 thru R63, R88,R103	852-312102-001	Resistor, 1K Ohm, ± 5%, 1/4W	9
R64,R76	852-312683-001	Resistor, 68K Ohm, ± 5%, 1/4W	2
R71,R73	852-312475-001	Resistor, 4.7Megohm, ± 5%, 1/4W	2
R74,R75	852-312472-001	Resistor, 4.7K Ohm, ± 5%, 1/4W	2
R81,R82	853-429311-031	Resistor, 9.31K Ohm, ± 1%, 1/4W	2
R83	853-427151-031	Resistor, 7.15K Ohm, ± 1%, 1/4W	1

TABLE 6-5
POLYMOOG KEYBOARD PROGRAM CONTROL PRINTED CIRCUIT TR BOARD 9 ASSEMBLY
REPLACEMENT PARTS LIST
(Continued)

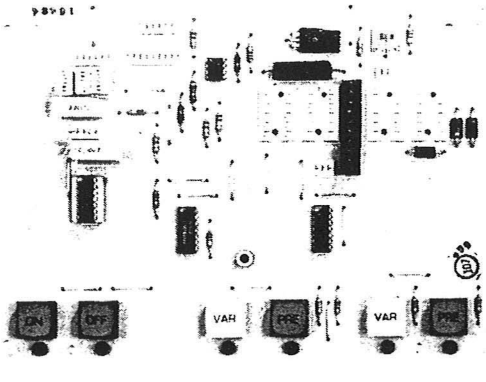
INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
R84	853-312334-001	Resistor, 330K Ohm, ±5%, 1/4W.	1
R87	852-312221-001	Resistor, 220K Ohm, ±5%, 1/4W.	1
R90	852-312471-001	Resistor, 470 Ohm, ±5%, 1/4W	1
R97	852-312222-001	Resistor, 2.2K Ohm, ±5%, 1/4W.	1
R98	852-312301-001	Resistor, 300 Ohm, ±5%, 1/4W	1
R99	852-312911-001	Resistor, 910 Ohm, ±5%, 1/4W	1
R102	852-312332-001	Resistor, 3.3K Ohm, ±5%, 1/4W.	1
	906-040307-007	Socket, Integrated Circuit, SIL, 7 Pin, AMP1-583773-4	10
	906-040307-008	Socket, Integrated Circuit, SIL, 8 Pin, AMP1-583773-5	12
	906-042012-008	Socket, Integrated Circuit, DIP, 8 Pin, AMP583640-1	2
	906-042772-008	Socket, Integrated Circuit, 8 Pin, (Mod.)	52


moog
VAR
PRE
LOCK
MAN
LOWER
UPPER
ALL
ON
OFF
ON
OFF
VAR
PRE
LOWER
UPPER
ALL
SPLIT

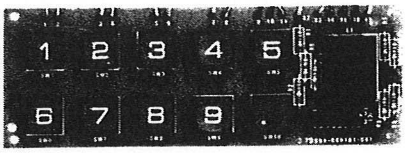
POLYMOOG RIGHT HAND CONTROL BOARD 11


moog
VAR
PRE
VAR
PRE
FREE
LOCK
VAR
PRE
VAR
PRE

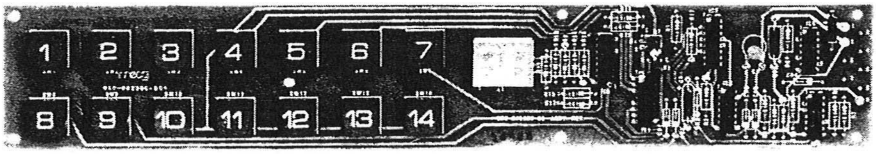
POLYMOOG LEFT HAND CONTROL BOARD 10


ON
OFF
VAR
PRE
VAR
PRE

POLYMOOG KEYBOARD LEFT HAND CONTROL BOARD 10

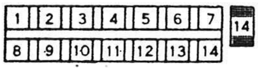


POLYMOOG MODE SELECTOR BOARD 12


1
2
3
4
5
6
7
8
9
10
11
12
13
14
moog

POLYMOOG KEYBOARD MASTER VOICE SELECTOR BOARD 12

1
2
3
4
5
9
6
7
8
9
•


1
2
3
4
5
6
7
14
8
9
10
11
12
13
14

SECTION 7
BOARDS 10, 11, 12
LEFT HAND CONTROL, RIGHT HAND CONTROL, MODE SELECTOR, AND MASTER VOICE SELECTOR
CL and CR

7.1 LEFT HAND CONTROL PANEL CIRCUIT DESCRIPTION (BOARD 10) – POLYMOOG

Circuitry contained on the left hand control panel (CL) provides direct digital control signals and control currents for various variable functions in a manner similar to that described for the right hand control assembly. (Refer to Paragraph 7.6.)

Gates G1 thru G3 comprise a tri-flop set to one of three stable states by switches SW1 thru SW3. These switches control selection of SAWTOOTH only, RECTANGULAR waveshape only or sawtooth plus rectangular waveshape for the lower two octave keyboard section. In addition to control of this latch by switches SW1 thru SW3, a particular state may be selected for each of eight presets via programming diodes CR1 thru CR8, CR9 thru CR16 and CR17 thru CR24. These diodes are driven by the S1 thru S8 lines connected to the front panel preset control pushbuttons on the mode selector panel. When a particular preset is selected, the respective S line goes to 0 VDC setting a particular status of this latch comprised of G1 thru G3. Programming is accomplished by putting a diode in one of three possible positions with only one diode attached to the S1 line, S2 line, etc. Thus a total of eight diodes is required to program the status of this tri-flop for all eight presets. A particular state of this tri-flop is active when the respective G1 thru G3 output is low (0 VDC). The sawtooth only and rectangular only latched sections drive open collector gates G7 and G8. These gates are used to inhibit the nonselected waveform via a shutdown diode on the TL board. For example, if switch SW1 is depressed, the output of G1 goes low and the output of G7 goes high. This G7 high signal is applied to the rectangular pulse width control section driving the mother board buss line negative which deletes any rectangular output waveform on the mother board.

A second tri-flop, comprised of G4 thru G6 with associated drivers G9 and G10, operates in a manner identical to that described for the LOWER KEYBOARD and is used to control waveshape selection for the UPPER KEYBOARD.

Octave pitch selection for the sawtooth and rectangular ranks is controlled by two latches comprised of G11/G12 and G13/G14. The first latch determines whether FOOTAGE for the sawtooth rank is 8 or 4 and the second latch determines whether FOOTAGE for the rectangular rank is 16 or 8. Programming of these two latches for various preset modes is determined via diodes CR49 thru CR56, CR57 thru CR64, CR65 thru CR72 and CR73 thru CR80 in a manner identical to that described previously.

VAR-PRE tuning of the sawtooth rank is controlled by a latch comprised of G15, G16 and the associated CMOS switch package and inverter IC8. The latch may be controlled either by front panel VAR-PRE switches SW11 or SW12 or via the RP1 and VP1 lines which go negative when any one of eight presets is selected or VARIABLE mode No. 9 pushbutton is depressed, respectively. This latch connects either preset network N1 or ∿ RANK TUNE control R20 to the POITN line via the FET switches contained in IC8. The various FETs in IC8 are connected to comprise a level translator and inverter and two N channel FETs for alternate switching action. The ∿ RANK TUNE control R20 feeds current to the POITN line when the appropriate FET is on via feed resistor R17. Bias resistor R18 sinks current so that when the ∿ RANK TUNE control is centered, approximately no current flows to the POITN line. Diode CR81 is used to prevent input voltage on pin 5 from going negative when the FET switch associated with pin 5 is off, preventing any off current from leaking to the POITN line via the substrate of IC8.

The latch comprised of G17 and G18 controls VAR-PRE selection of FREQUENCY MODULATION rates and amounts for the two oscillator ranks via FET switch packages IC9, IC10, IC12 and IC13. The TTL level from the latch is level translated and inverted in IC9. The inverted signal is fed in common to the remaining three switch packages. This inverted signal from pin 10 of IC9 is used to drive these switch packages in a manner similar to that described for the CR board whereby each pack acts as a single-pole, double-throw switch connecting either the associating resistor network or the related front panel control to the output port.

Programming resistor packs N2, N3, N5 and N6 are driven in common by preset lines P1 thru P8 of which one, at any given time, is 10.0 VDC while all others are zero. Pin 2 of these four resistor programming packs is connected to the emitter of a drive transistor whose collector is connected to string mode preset line P1. The bases of transistors Q1 thru Q4 are tied together in common and are driven by string contour generator line MACG via limit resistor R21. This common connection is labeled XX. By placing the resistor in position 2 of the resistor pack, the drive voltage applied to pin 2 of these packs is modulated by the string contour generator contained on the TR board to provide delayed frequency modulation amounts and rates when the instrument is in the STRING mode.

The latch comprised of G21 and G22 controls the VAR-PRE selection for low and high sawtooth level via switching packs IC11 and IC14 operating identically to those previously described. The latch may be controlled either by VAR-PRE switches SW15 and SW16 on the front panel or the RP1 and VP1 lines for automatic status setting of this latch.

Switching the instrument between the LOCK and FREE modes is accomplished by a latch comprised of G25 and G26. This latch may be programmed to a particular state for each of the presets via programmed diodes CR82 thru CR89 and CR90 thru CR97.

Variable or preset control of the RECTANGULAR WAVESHAPE PULSE WIDTH, PULSE WIDTH MODULATION and MODULATION RATE is controlled via a latch comprised of G23 and G24 and switch packs IC15 thru IC20. The status of this latch is controlled by front panel VAR-PRE switches SW17 SW18 or via the RP1 and VP1 lines as described previously. The switch packs in this section provide for VAR-PRE control of the rectangular pulse width for the lower keyboard section, the pulse width modulation for the lower keyboard, the rectangular waveshape for the upper keyboard and the pulse width modulation for the upper keyboard. Note that the program networks for the pulse width modulation low and high circuit have pin 2 connected to the emitter of a transistor which is driven from the XX line. This XX line is connected to the string contour generator providing delayed pulse width modulation when the instrument is in the string mode.

Circuitry associated with the pitch controller-RIBBON is contained on the CL board and is comprised of R59 thru R61. The pitch controller is comprised of a 10K resistor over which is stretched a metallic contact element. The element does not normally touch the distributed 10K resistor element R62. When the ribbon is depressed, this contact element, connected to the RIBR line, touches some point on the distributed resistor element causing a position dependent voltage between approximately -0.5 and +0.5 VDC to appear on the RIBR line. Pitch controller center adjust trim pot R60 provides for center trimming of the ribbon element, that is, an adjustment of the end point voltages of the ribbon so that when the ribbon element is depressed exactly in the center, 0.0 VDC appears on the RIBR line.

Filter glide control is accomplished via divider front panel EXT KB GLIDE control R63 and feed resistor R64 and applied directly to the CR board. This particular instrument function is not programmed for the various presets since it is used primarily for external synthesizer effects.

The elements labeled CP1, CP2 and CP3 are circuit protection Zener diodes providing overvoltage protection for the +5, +15 and -15 supply voltages, respectively. These power Zener diodes clamp voltages at approximately +6.8, +16 and -16 volts respectively should a power supply overvoltage occur.

The preset switch lines SP1 thru SP9, RP1 line and preset drive lines P1 thru P8 are connected to the CR board via connectors P104 and P105.

Power enters and leaves the CL board through connectors P102 and P107 and distribution rails on this board serve as the master ground and supply reference points for the +5, +15 and -15 VDC supplies. Both the supply and ground sense lines for these two supplies are referenced to the left hand control board at connectors P102 and P107.

NOTE

The power supply output voltages must be checked and adjusted if necessary (refer to Table 8-1) prior to all troubleshooting and alignment procedures.

7.2 LEFT HAND CONTROL PANEL ASSEMBLY ALIGNMENT

a. PITCH CONTROLLER CENTERING ADJUSTMENT

1. Connect dc voltmeter between pin 1 of P73 (terminal 24 of board 10) and ground. Depress PITCH CONTROLLER at the center directly above the raised rib on the ribbon and adjust trim pot R60 for a voltage indication of 0.0 ± 0.1 VDC. (Volume II).

7.3 TROUBLESHOOTING

Troubleshoot the left hand control printed circuit board using Table 7-1, the circuit description paragraph 7.1, and part location and schematic diagrams in Volume II.

TABLE 7-1
POLYMOOG LEFT HAND CONTROL CL BOARD 10 TROUBLESHOOTING

PROBLEM	PROBABLE DEFECTIVE COMPONENTS
Keyboard lower waveshape selection switch control response defective	IC1, IC3, L1 thru L3
Keyboard upper waveshape selection switch control response defective	IC2, IC3, L4 thru L6
8′ - 4′ sawtooth rank control switch response defective	IC4, L7, L8
16′ - 8′ square wave rank control switch response defective	IC4, L9, L10
Sawtooth RANK TUNE VAR-PRE latch response defective	IC5, L11, L12
Sawtooth RANK TUNE control R20 response defective	IC8
FM section VAR-PRE switch control defective	IC5, L13, L20
FM1 RATE control R26 response defective	IC9, N2, Q1
FM2 RATE control R29 response defective	IC10, N3, Q2

TABLE 7-1
POLYMOOG LEFT HAND CONTROL CL BOARD 10 TROUBLESHOOTING (Continued)

PROBLEM	PROBABLE DEFECTIVE COMPONENTS
FM1 AMT control R41 response defective	IC12, N5, Q3
FM2 AMT control R43 response defective	IC13, N6, Q4
Sawtooth level VAR-PRE switch control response defective	IC7, L14, L15
Sawtooth RANK MIX level LOWER control R34 response defective	IC11, N4
Sawtooth RANK MIX level UPPER control R45 response defective	IC14, N7
Rectangular waveshape VAR-PRE switch control response defective	IC7, L16, L17
Waveshape FREE-LOCK switch control response defective	IC6, L18, L19
Rectangular SHAPE LOWER control R46 response defective	IC15, N8
Pulse width modulation LOWER AMT control R49 response defective	IC16, N9, Q5
Rectangular SHAPER UPPER control R51 response defective	IC17, N10, IC19, N12
Pulse width modulation UPPER AMT control R53 response defective	IC18, N11, Q6
Pulse width modulation UPPER RATE control R57 response defective	IC20, N13

TABLE 7-2
POLYMOOG LEFT HAND CONTROL PANEL PRINTED CIRCUIT CL BOARD 10 ASSEMBLY REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-040169-001	Left Hand Control Panel Printed Circuit Board Assembly, consisting of:	
	910-040311-001	Pin, Printed Circuit Board, 0.058, AMP60973-1	30
	973-040947-011	Standoff (PEML 0.187), KFE 143-6	3
CP1	919-041072-001	Circuit Protector, P6KE6.8, Zener Diode, Transorb	2
CP2,CP3	919-041073-001	Circuit Protector, P6KE16A, Zener Diode, Transorb	1
CR8,CR15, CR17 thru CR22,CR32, CR39,CR41 thru CR46, CR49,CR50, CR53,CR55, CR56,CR59, CR60,CR62, CR67,CR73, CR74,CR76 thru CR81, CR83,CR85 thru CR88, CR90,CR92, CR97	919-041075-001	Diode, 1N4148, Alternate, 1N914	41
IC1 thru IC7	991-041093-001	Integrated Circuit, SN7401	7
IC8 thru IC20	991-041086-001	Integrated Circuit, CMOS, CD4007AE	13
L1 thru L20	939-040875-001	Diode, Light Emitting, Red, SSL-22	20
N1	949-040466-001	Resistor Network, Tone	1
N2	949-040454-001	Resistor Network, FM 1 Rate (R2)*	1
N3	949-040455-001	Resistor Network, FM 2 Rate (R2,R6,R7,R9)*	1
N4	949-040456-002	Resistor Network, Low Level, (R1,R3 thru R9)*	1
N5	949-040457-001	Resistor Network, FM 1 Amount (R2)*	1
N6	949-040458-001	Resistor Network, FM 2 Amount (R2,R5 thru R7,R9)*	1
N7	949-040459-002	Resistor Network, High Level (R1,R3 thru R9)*	1
N8	949-040460-001	Resistor Network, Low Shape (R1,R3 thru R9)*	1
N9	949-040461-001	Resistor Network, Low Modulation (R2 thru R7)*.	1
N10	949-040462-001	Resistor Network, High Shape (R1,R3 thru R9)*	1
N11	949-040463-001	Resistor Network, High Modulation (R2 thru R7)*.	1
N12	949-040464-001	Resistor Network, Medium Shape (R1, R3 thru R9)*	1
N13	949-040465-001	Resistor Network, Rate (R1,R3,R4,R6,R7)*.	1
P101,P106	910-040299-003	Header, Printed Circuit, 3 Pin, (0.1 Centers), AMP640098-3.	2
P102	910-040299-009	Header, Printed Circuit, 9 Pin, (0.1 Centers), AMP640098-9.	1
P103	910-040299-007	Header, Printed Circuit, 7 Pin, (0.1 Centers), AMP640098-7.	1
P104	910-040299-010	Header, Printed Circuit, 10 Pin, (0.1 Centers), AMP1-640098-0.	1
		* See Schematic Diagram for Resistor Values (± 5%, 1/4W)	

TABLE 7-2
POLYMOOG LEFT HAND CONTROL PANEL PRINTED CIRCUIT CL BOARD 10 ASSEMBLY
REPLACEMENT PARTS LIST (Continued)

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
P105	910-040299-008	Header, Printed Circuit, 8 Pin, (0.1 Centers), AMP640098-8.	1
P107	910-040314-024	Header, Printed Circuit, MR, 24 Pin, AMP9-350273-1	1
Q1 thru Q6	991-040017-001	Transistor, NPN, 2N3392	6
R1,R4,R8, R11,R13,R22, R30,R36,R38	852-312181-001	Resistor, 180 Ohm, ± 5%, 1/4W	9
R2,R5,R7, R9,R10,R12, R14,R23,R31, R37,R39	852-312102-001	Resistor, 1K Ohm, ± 5%, 1/4W	11
R3,R6	852-312471-001	Resistor, 470 Ohm, ± 5%, 1/4W	2
R15,R19,R24, R27,R32,R35, R48,R56	852-312104-001	Resistor, 100K Ohm, ± 5%, 1/4W	8
R16	925-040266-001	Resistor, Trimpot, 10K Ohm	1
R17	853-224223-021	Resistor, 422K Ohm, ± 1%, 1/8W.	1
R18	852-312824-001	Resistor, 820 Ohm, ± 5%, 1/4W	1
R21	852-312223-001	Resistor, 22K Ohm, ± 5%, 1/4W	1
R25,R28	854-312154-001	Resistor, 150K Ohm, ± 5%, 1/4W.	2
R33,R44,R47, R52,R55,R64	852-312273-001	Resistor, 27K Ohm, ± 5%, 1/4W	6
R40	852-312183-001	Resistor, 18K Ohm, ± 5%, 1/4W	1
R42	852-312123-001	Resistor, 12K Ohm, ± 5%, 1/4W	1
R50,R54	852-312153-001	Resistor, 15K Ohm, ± 5%, 1/4W	2
R59	852-312472-001	Resistor, 4.7K Ohm, ± 5%, 1/4W	1
R60	925-040266-008	Resistor, Trimpot, 1K Ohm	1
R61	852-312432-001	Resistor, 4.3K Ohm, ± 5%, 1/4W	1
R68,R69,R70	852-312304-001	Resistor, 300K Ohm, ± 5%, 1/4W.	3
SW1,SW4	960-040224-001	Switch, Pushbutton, Gray /|/|/	2
SW2,SW5	960-040224-002	Switch, Pushbutton, Gray ⎍⎍	2
SW3,SW6	960-040224-003	Switch, Pushbutton, Gray /|/|/	2
SW7,SW10	960-040224-005	Switch, Pushbutton, Gray, 8′ ⎍⎍	2
SW8	960-040224-004	Switch, Pushbutton, Gray, 4′	1
SW9	960-040224-006	Switch, Pushbutton, Gray, 16′	1
SW11,SW13, SW15,SW17	960-040222-001	Switch, Pushbutton, White, VAR.	4
SW12,SW14, SW16,SW18	960-040224-007	Switch, Pushbutton, Gray, PRE	4
SW19	960-040224-008	Switch, Pushbutton, Gray, LOCK	1
SW20	960-040224-009	Switch, Pushbutton, Gray, FREE	1
	906-040307-007	Socket, Integrated Circuit, SIL, 7 Pin, AMP1-583773-4	26
	906-040307-010	Socket, SIL, 10 Pin, AMP1-583773-3	10

7.4 POLYMOOG KEYBOARD LEFT HAND CONTROL BOARD CIRCUIT DESCRIPTION (BOARD 10)

The LEFT HAND CONTROL (CL) board in Polymoog Keyboard provides the following major functions:

a. Power supply distribution.
b. All VAR/PRE, ON/OFF logic switching.
c. -5.5 VDC power supply.

VARIABLE/PRESET control for the ATTACK is accomplished through gates IC1C and IC1D which constitute a cross-coupled latch, driving panel indicators L1 and L2. IC1D pin 13 will be low (0 VDC) in the PRE state and high (+5 VDC) in the VAR state. This output is routed through open collector output inverter IC2C to board 9.

VARIABLE/PRESET control for the MODULATION is accomplished in the same manner with gates IC1A and IC1B driving panel indicators L5 and L6. IC1B pin 4 will be low in the PRE state and high in the VAR state and is routed to board 9.

ON/OFF control for BASS FILTER is also accomplished in the same manner with gates IC2A and IC2B driving panel indicators L3 and L4. IC2A pin 3 will be low for the ON state and high for the OFF state and is routed to inverter IC2D.

The RPI line from the MASTER VOICE SELECTOR board 12 is applied to P106 pin 1 and to one input of each of the three latches described above. Whenever one of the fourteen preset buttons is depressed, the RPI line goes low. This will force the ATTACK and MODULATION latches to their PRESET state and the BASS FILTER latch to its OFF state.

Audio output from the LOW MOTHER board is applied to P101 pin 1 and drives the top of front panel BAL 1 through 2, potentiometer R19 and the BASS FILTER (on board 8) by way of AC coupling capacitor C3. Assuming the BASS FILTER latch is in the OFF state and there is no plug inserted in the rear panel BASS OUT jack J10, IC2D pin 11 will be low (described above). Therefore, IC3A will be off, opening the low audio path to the BASS FILTER, and since IC3B is used as an inverter, its output will be high. This will turn IC3D on and complete the low audio path to the filter drive amplifier on board 8. If the BASS FILTER is turned ON, the states will be reversed and IC3B will be on, completing the audio path to the input of the BASS FILTER. IC3D will be off, breaking the audio path to the filter drive amplifier. The output of the BASS FILTER is routed through front panel BASS LEVEL potentiometer R55 to the BASS OUT jack J10, via C1, and to bilateral switch IC3C. The control input of IC3C is connected to the ring terminal of J10. With no plug inserted in J10 it will be high, turning IC3C on and completing the audio path to the mix output amplifier on board 8. Inserting a mono (one circuit) plug in J10 will short the ring to ground, turning IC3C off and severing the audio path to the mix output amplifier.

The -5.5 VDC supply rail is developed by inverting amplifier A1. Vcc is used as the reference voltage and applied through summing resistor R10. Emitter follower Q1 is connected inside the feedback loop to provide current gain. R12 reduces the possibility of oscillation and R13 lowers the power dissipation in Q1.

7.5 TROUBLESHOOTING

Troubleshoot the left hand control board in accordance with Table 7-3, the circuit description paragraph 7.4 and the parts location and schematic diagrams contained in Volume II.

TABLE 7-3
POLYMOOG KEYBOARD LEFT HAND CONTROL CL BOARD 10 TROUBLESHOOTING

PROBLEM	PROBABLE DEFECTIVE COMPONENT
ATTACK switching inoperative	IC1, IC2
BASS filter switching inoperative	IC2, IC3
MODULATION switching inoperative	IC1
Inoperative -5.5 VDC supply	A1, Q1
+5V, +15V or -15V supplies shorted to ground	CP3

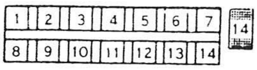


TABLE 7-4
POLYMOOG KEYBOARD LEFT HAND CONTROL PANEL PRINTED CIRCUIT CL BOARD 10 ASSEMBLY REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-042503-001	Left Hand Control Panel Printed Circuit Board Assembly, consisting of:	
A1	991-041101-001	Integrated Circuit, Operational Amplifier, 741	1
C1,C2	946-040229-105	Capacitor, Polyester, 1uf	2
C3,C4,C5	946-040229-474	Capacitor, Polyester, 0.47uf	3
CP1	919-041072-001	Voltage Suppressor, P6KE6.8	1
CP2,CP3	919-041073-001	Voltage Suppressor, P6KE16A	2
IC1	991-041093-001	Integrated Circuit, SN7401	1
IC2	991-041096-001	Integrated Circuit, SN7426	1
IC3	991-041087-001	Integrated Circuit, CMOS, CD4016AE	1
L1 thru L6	939-040875-001	LED, Red, Opcoa, LSM-6	6
P101	910-040299-007	Header, Printed Circuit, 7 Pin, (0.1 Centers), AMP640098-7	1
P102	910-040299-009	Header, Printed Circuit, 9 Pin, (0.1 Centers), AMP640098-9	1
P103	910-040299-005	Header, Printed Circuit, 5 Pin, (0.1 Centers), AMP640098-5	1
P104	910-040299-006	Header, Printed Circuit, 6 Pin, (0.1 Centers), AMP640098-6	1
P105,P106	910-040299-003	Header, Printed Circuit, 3 Pin, (0.1 Centers), AMP640098-3	2
P107,P108, P109, P1011 thru P1015	910-040303-006	Header, Printed Circuit, 6 Pin, Keyed, (0.150 Centers), AMP640242-6	8
P1010	910-042533-010	Header, Printed Circuit, 10 Pin, (0.156 Centers), AMP1-640444-0	1
Q1	991-041050-001	Transistor, PNP, TIP30	1
R1,R2,R3, R5,R7,R8	852-312181-001	Resistor, 180 Ohm, ±5%, 1/4W	6
R4,R6,R10, R17,R18,R22	852-312104-001	Resistor, 100K Ohm, ±5%, 1/4W.	6
R9	853-421103-031	Resistor, 110K Ohm, ±5%, 1/4W.	1
R11	852-312270-001	Resistor, 27 Ohm, ±5%, 1/4W.	1
R12	852-312473-001	Resistor, 47K Ohm, ±5%, 1/4W	1
R13	924-040187-001	Resistor, 16 Ohm, ±5%, 5W	1
R14	852-312472-001	Resistor, 4.7K Ohm, ±5%, 1/4W	1
R15	925-040266-008	Resistor, 1K Ohm, Trim Pot	1
R16	852-312432-001	Resistor, 4.3K Ohm, ±5%, 1/4W	1
SW1,SW5	960-040222-001	Switch, Pushbutton, White, VAR.	2
SW2,SW6	960-040224-007	Switch, Pushbutton, Gray, PRE	2
SW3	960-040224-010	Switch, Pushbutton, Gray, ON	1
SW4	960-040224-011	Switch, Pushbutton, Gray, OFF	1
	973-040947-011	Standoff (PEML = 0.187), KFE 143-6	1
	906-040307-007	Socket, Integrated Circuit, SIL, 7 Pin, AMP1-583773-4	2
	816-040039-006	Screw, No. 6B, Self Tapping, 3/8 in. long	1
	902-042525-001	Nut, Speed, Type W, Tinnerman C224-6Z-4	1

7.6 RIGHT HAND CONTROL AND MASTER PRESET ASSEMBLY CIRCUIT DESCRIPTION (BOARD 11) - POLYMOOG

The right hand control and master preset assembly (CR) performs three major functions: (1) provides control current and logic levels to the top boards; (2) contains preset (load) logic and drive circuitry; and (3) provides audio reference voltage V_{ch} = 4.85 VDC) and -5.5 VDC voltage rail. (See Volume II.)

The CR board contains the VAR-PRE switching for the voltage controlled filter and loudness contour sections. Variable preset control for the voltage controlled filter is accomplished via G1 and G2, a cross-coupled latch driving front panel indicators L1 and L2. Switching of this latch is accomplished via VAR and PRE switches SW1 and SW2. A particular state of the latch is active when the associated output line is low "0." For example, the voltage controlled filter is in the VAR mode when pin 13 of IC1 is low. The TTL latch, comprised of G1 and G2, is routed directly to the top right board (board 9) containing the voltage controlled filter for VAR-PRE gain compensation.

In addition, the output of this latch is applied to a level translator comprised of an N channel transistor and R3. When input voltage at pin 6 of IC2 drops to ground potential, the voltage at pins 3 and 8 increases to +15 volts turning off the P channel transistor associated with pin 2 of IC2 and causing the voltage on pins 1 and 10 to go to 0. This output on pin 10 of IC2 is used as a common drive line (ZZ line) to IC3 thru IC10 which perform the VAR-PRE current switching for their associated functions.

When the voltage controlled filters are in the variable mode, the voltage at pin 3 of IC2 is high turning on the N channel transistor associated with pin 4. This allows current to be supplied from the front panel S&H slide control via R6 to the sample and hold control node, PVSHN. At the same time, voltage on pin 10 of IC2 is low, turning off the N channel transistor associated with pin 9 preventing any current from preset resistor network N5, driven by the P lines (P1 thru P8), from reaching the sample and hold control node, PVSHN. Thus IC2 acts as a single-pole, double-throw switch routing current from either the front panel slide control or from resistor network N5 to the control node.

The ZZ drive line controls the remaining functions associated with the voltage controlled filter. This ZZ line is directly coupled via pin 3 to all of the N channel FETs which switch in control currents for the preset modes. In addition, this ZZ line is coupled to pin 6 of each of these switching packs and inverted by the P and N channel FETs associated with pins 14 and 7, respectively (this inverter drives the N channel FET coupled to the front panel slide control current source). Thus IC2 thru IC10 are all simultaneously switched between the VAR-PRE modes via the latch comprised of G1 and G2. The P1 thru P8 lines are driven from buffer amplifiers and only one of eight P lines is active at any one time, determined by which preset mode is selected. The active preset mode is indicated by the seven segment display on the mode selector control assembly.

The VAR-PRE latch comprised of G1 and G2 is also controlled by the RP1 and VP1 lines. Whenever one of the eight preset pushbuttons is depressed, the RP1 line goes negative (0 VDC) forcing pin 10 of IC1 to go to 0 placing the latch in the preset mode. Whenever pushbutton No. 9 on the mode selector panel is depressed, the VP1 line goes negative forcing the latch comprised of G1 and G2 to go to the VAR mode. This latch may thereby be switched either locally via front panel switches or remotely through mode selector controls.

The ON-OFF, LOWER-UPPER and ALL-SPLIT modes of the VCF are controlled by three similar latches comprised of G3/G4, G5/G6 and G9/G10. The ON-OFF latch is forced to the ON state whenever either VP1 or RP1 line goes active "0." Similarly, the ALL-SPLIT latch is forced to the ALL mode. In addition, the ALL mode is coupled to the LOWER-UPPER latch through the top right board such that whenever the VCF is in the ALL mode, the VCF keyboard mode latch is forced into the UPPER state.

The brightness latch is comprised of gates G7 and G8 and is switched via the RP1 and VP1 lines as described previously. This latch drives CMOS analog switches in IC16, a configuration identical to that of IC2. However, the brightness does not have any associated front panel control but rather a fixed current provided via R32 when the brightness control is switched to variable (by VP1).

Front panel switching control for the RESONATOR section is accomplished via gates G11 thru G22. Gates G11 thru G13 are cross-coupled in such a manner to provide a tri-flop. Whenever anyone of these three gates is on, that is, 0 VDC, it forces the output of the two remaining gates high which gives a self-consistent stable state. Switching between the ALL, UPPER and LOWER modes is accomplished by switches SW9 thru SW11. The outputs of this tri-flop are encoded by gates G19 and G20 so that when the tri-flop is in the ALL mode, both outputs of G19 and G20 are +15 VDC and if the tri-flop is in either the UPPER or LOWER mode, respective gate G19 or G20 is positive while the other is negative. These lower-upper switching signals are routed to the top center board for audio switching control. Gates G14 thru G16 provide resonator and mode ON-OFF control. Gate G15 is currently not used and its output is forced to a "1" by grounding pin 9. Thus gates G14 and G16 act as a simple cross-coupled latch controlled by ON-OFF switches SW12 and SW13 on the front panel. The output of G21 is routed to the top center board for ON-OFF audio switching of both the RESONATOR and MODE audio paths.

The RESONATOR section is forced into the ALL and ON modes whenever one of eight presets is activated via the RP1 line and R97. When pushbutton No. 9 is depressed, the resonators are forced into the ON mode via the VP1 line but keyboard mode switching is unaffected.

The FINAL DECAY LOCK-MAN mode is controlled by the cross-coupled latch comprised of G17 and G18 which is controlled by front panel switches SW14 and SW15. The RP1 line sets this latch to the MAN mode, defeating unconditional final decay.

The amount of keyboard control voltage fed to the voltage controlled filter is determined by preset network N10 and front panel KB variable control R42. In this particular case, the variable control feed resistor and the CMOS switching pack are contained on the TR board. The loudness contour VAR-PRE switching is accomplished via the cross-coupled latch comprised of G23 and G24 which operates in a manner identical to those described for the voltage controlled filter. The configuration of IC19 is the same as for IC2. In this case the XX line performs the same function as the ZZ line which is the common drive line for the various switching packs within a section.

The CR board also contains logic associated with preset mode switching which controls the front panel seven segment indicator and P lines which drive the preset resistor packs. The SP1 thru SP8 lines are connected to momentary contact switches on the front panel via connector P115. In addition, the VP1 line is connected to No. 9 pushbutton via pin 1 of connector P115. Whenever one of No. 1 thru 9 mode selector pushbuttons is depressed, the respective SP line goes to "0." Encoder IC24 converts the linear input code on the SP lines to binary form on the A1, A2, A3 and GS lines. Whenever any one of the SP1 thru SP8 lines is switched to ground potential, the GS line goes negative in turn causing the output of G32 to go positive causing the RP1 line to go negative via G33 if, and only if, the decimal point line, DECPT is positive (the OFF state for the decimal point). When No. 9 pushbutton is depressed, the output of G25 goes positive. Whenever any one of the SP lines goes negative, or pin 5 on IC24 goes positive, the output on pin 15 which is coupled to Schmitt trigger gate G29 via R64 goes positive. Capacitor C4 provides for approximately 1 msec delay before G29 goes negative. This negative going transition is differentiated producing a narrow pulse via C6 and R66 and is applied to second Schmitt trigger gate G30 to provide a narrow positive pulse to the clock input of quad latch IC28. At the time a clock pulse appears on pins 4 and 13 of the quad latch, a binary representation of the preset number is present on pins 2, 3, 6 and 7. This quad latch remembers (in binary) which preset (mode) pushbutton was pushed last. The outputs of the latch are further encoded via gates G34, G35 and G40 to generate the IDLA-D code applied to the seven segment decoder driver on the mode selector control board. In addition, the binary code from the quad latch is applied to level translator gates G36 thru G38 to provide 0 to 15 VDC drive for mode selection switching on the TC board. These binary encoded versions of the preset number are 15 volt signals identified as SPB lines and drive analog switch A21 contained in IC31.

Decoder IC31 is a bilateral 8 to 1 analog multiplexer. The binary code presented at pins 9 thru 11 of IC31 causes one of the 50K ohm resistors R89 thru R96 to be connected to the resistor divider comprised of R87 and R88. This connection results in a precision potential of 10.0 VDC at the top of the 50K ohm resistor. This voltage is buffered by one of follower amplifiers A2A, A2B, A3A etc., driving the P lines which drive the preset resistor networks for preset control of the various instrument variables.

The VP1 line is connected directly to No. 9 pushbutton switch on the front panel. The RP1 line is derived from AND gate G33 and is enabled via decimal point line DECPT, whose origin is the Q output of the flip-flop in IC26. When the decimal point switch on the front panel is depressed, pin 1 of P112 goes to ground. The RC network comprised of R61 and C2 provides switch debouncing for Schmitt trigger G27 which drives the clock input of the flip-flop. This clock pulse causes the flip-flop in IC26 to reverse its state, that is, to toggle. Thus successive depressions of the decimal point pushbutton cause the decimal point line to go ON and OFF. If the decimal point light on the front panel is on, the DECPT line is a "0" and RP1 gate G33 is disabled. Thus when the decimal point light is on, depression of one of the eight presets does not reset the VAR-PRE latches on the control board to the PRE mode. Therefore the decimal point pushbutton acts as a cancel defeat.

In the current Polymoog, transistors Q3 and Q4 have been removed. This results in a 0 potential being applied to pins 1 and 3 of IC26 which holds the preset line, pin 10 of IC26, inactive. Thus gate G26 in IC26 is not used.

The +4.85 VDC audio reference rail voltage (V_{ch}) and the -5.5 VDC rail voltage are derived from the +15 VDC source by a voltage divider comprised of R70 thru R72. The divided down voltage is applied to the +4.85 VDC regulator comprised of A1A, R77 and power transistor Q1. The output voltage is fed back to high gain amplifier A1A via R74. The current for the +4.85 VDC supply is drawn from V_{cc} (+5.0 VDC) via the collector and emitter of Q1. This arrangement prevents the output voltage of the +4.85 VDC regulator from going above 5.0 VDC should Q1 short. The +4.85 VDC supply serves as the reference for the -5.5 VDC supply via trim pot R75 and resistor R76. Amplifier A1B and power transistor Q2, along with feedback resistor R79, provide a conventional power regulator which may be trimmed to exactly -5.5 VDC using trim pot R75. The device labeled CP1 (circuit protector No. 1) is a power Zener diode rated at 12 volts. The two supply potentials discussed here are used to power all 71 modulator boards which may be damaged if the voltage across the modulator boards exceed 15 volts. Power Zener diode CP1 not only provides protection against this potential disaster but absorbs very fast voltage transients which might occur due to line voltage surges, static, etc.

Connector P111 applies power from the left control board to the right control board and from this board to other Polymoog circuitry.

7.7 RIGHT HAND CONTROL AND MASTER PRESET ASSEMBLY ALIGNMENT

a. +4.85 VDC ADJUSTMENT

1. Connect d-c voltmeter between emitter of Q1 and ground (green wire on accessory connector) and adjust trim pot R71 for a voltage indication of 4.85 VDC ± 10 mv. (Refer to Volume II.)

b. 5.5 VDC ADJUSTMENT

1. Perform +4.85 VDC adjustment (step a above) and connect voltmeter to emitter of Q2. Adjust trim pot R75 for a voltage indication of -5.50 VDC ± 10 mv. (Refer to Volume II.)

7.8 TROUBLESHOOTING

Troubleshoot the right hand control board by referring to the circuit description, paragraph 7.6, Table 7-5 and the part location and schematic diagrams in Volume II.

TABLE 7-5
POLYMOOG RIGHT HAND CONTROL CR BOARD 11 TROUBLESHOOTING

PROBLEM	PROBABLE DEFECTIVE COMPONENTS
LOUDNESS CONTOUR VAR-PRE control or keyboard response defective	IC18, L18, L19
KB DYN control R47 response defective	IC19
UPPER KEYBOARD D/R control R49 response defective	IC20, N14
LOWER KEYBOARD D/R control R51 response defective	IC21, N15
ATTACK control R53 response defective	IC22, N16
SUSTAIN control R55 response defective	IC23, N17
VCF VAR-PRE latch defective	IC1, L1, L2
CUTOFF control R9 response defective	IC4, N3
EMPH control R11 response defective	IC5, N4
MODULATION AMT control R13 response defective	IC6, N1
MODULATION RATE control R7 response defective	IC3, N2
Sample & Hold (S&H) control R5 response defective	IC2, N5 **NOTE:** Add R98, 100K resistor to improve reliability for Polymoogs with serial No's below 3000.
CONTOUR AMT control R21 response defective	IC10, N9
CONTOUR ATTACK control R17 response defective	IC8, N7, CR7
CONTOUR DECAY control R19 response defective	IC9, N8, CR8
CONTOUR SUSTAIN control R15 response defective	IC7, N6
VCF ON-OFF switch control latch response defective	IC1, L3, L4, CR1
VCF KEYBOARD LOWER-UPPER switch response defective	IC11, L5, L6

TABLE 7-5

POLYMOOG RIGHT HAND CONTROL CR BOARD 11 TROUBLESHOOTING (Continued)

PROBLEM	PROBABLE DEFECTIVE COMPONENTS
VCF KEYBOARD ALL-SPLIT switch response defective	IC11, L8, L9, CR2
RESONATORS LOWER-UPPER-ALL switch control response defective	IC13, L10 thru L12, IC15
RESONATORS ON-OFF switch control response defective	IC14, L13, L15, IC15, CR3
LOUDNESS CONTOUR FINAL DECAY LOCK-MAN switch control response defective	IC12, L16, L17
One of preset controls No. 1 thru 9 inoperative	SW1 thru SW9 on mode selector control board, IC24, IC25, IC28 thru IC31, A2 thru A5
All presets work but no display on readout indicator	IC1, L1 (both on mode selector control board)
Preset number shows on readout indicator but no internal preset control	IC31
No preset visual indication or operation	IC24, IC28, IC27, IC30
Decimal point control switch response inoperative	IC29, IC26, IC25, IC18, C2
RP1 line error	IC24, IC18, IC25, IC26
+4.85 VDC voltage rail noisy	Voltage trim pot R71 not adjusted properly, Q1, A1A
-5.5 VDC inoperative but +4.85 VDC correct	A1B, Q2, R80, CP1, trim pot R75 not adjusted properly
SPI line error	Q3, Q4, C10

TABLE 7-6

POLYMOOG RIGHT HAND CONTROL AND MASTER PRESET PRINTED CIRCUIT CR BOARD 11 ASSEMBLY REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-040165-001	Right Hand Control and Master Preset Printed Circuit Board Assembly consisting of:	
A1	991-041102-001	Integrated Circuit, Dual Operational Amplifier, MC1458CP-1	1
A2 thru A5	991-041084-001	Integrated Circuit, Dual Operational Amplifier, LM358N.	4
C1,C3,C5 thru C7,C11,C12	947-040200-103	Capacitor, Disc, 0.01uf	7
C2,C4	946-040231-002	Capacitor, Tantalum, 10uf, 6V	2
C8	946-040229-104	Capacitor, Polyester, 0.1uf.	1
CP1	919-041071-001	Circuit Protector, P6KE12A, Zener Diode, Transorb	1
CR1 thru CR3, CR7 thru CR10	919-041075-001	Diode, 1N4148, Alternate, 1N914	7
CR5	919-042019-001	Diode, 1N4004	1
C1,IC11, IC12,IC18, IC25	991-041093-001	Integrated Circuit, SN7401.	5
IC2 thru IC10, IC16,IC17, IC19 thru IC23	991-041068-001	Integrated Circuit, CMOS, CD4007AE	16
IC13,IC14	991-041094-001	Integrated Circuit, SN7410.	2
IC15,IC30	991-041096-001	Integrated Circuit, SN7426	2
IC24	991-041106-001	Integrated Circuit, 74148	1
IC26	991-041099-001	Integrated Circuit, SN7474.	1
IC27,IC29	991-041095-001	Integrated Circuit, SN7413	2
IC28	991-041100-001	Integrated Circuit, SN7475	1
IC31	991-041090-001	Integrated Circuit, CMOS, CD4051	1
L1 thru L6, L8 thru L13, 5 thru L19	939-040875-001	Diode, Light Emitting, Red, SSL-22.	17
N1	949-040433-002	Resistor Network, Modulation Amount (R1, R7)*	1
N2	949-040434-003	Resistor Network, Modulation Rate (R1,R5,R7)*	1
N3	949-040435-002	Resistor Network, Cutoff (R1 thru R8)*	1
N4	949-040436-002	Resistor Network, Emphasis (R1 thru R6)*	1
N5	949-040437-001	Resistor Network, Sample and Hold (R5)*	1
N6	949-040438-001	Resistor Network, Contour Sustain (R2 thru R4,R6 thru R8)*	1
N7	949-040439-002	Resistor Network, Contour Attack (R1 thru R4, R6 thru R8)*	1
N8	949-040440-002	Resistor Network, Contour Decay (R1 thru R4, R6 thru R8)*	1
N9	949-040441-002	Resistor Network, Contour Amount (R1 thru R4, R6 thru R8)* . . .	1
N10	949-040442-001	Resistor Network, Keyboard Amount (R1 thru R8)*	1
N11	949-040443-001	Resistor Network, Brightness Level (R1 thru R7)*	1
N12	949-040444-002	Resistor Network, Clamp Level (R1, R3 thru R5,R7,R8)*	1
N13	949-040445-002	Resistor Network, Dynamics (R1 thru R8)*	1
N14	949-040446-002	Resistor Network, Decay Upper (R1,R2,R4 thru R8)*	1
		* See Schematic Diagram for Resistor Values (± 5%, 1/4W)	

TABLE 7-6

POLYMOOG RIGHT HAND CONTROL AND MASTER PRESET PRINTED CIRCUIT CR BOARD 11 ASSEMBLY REPLACEMENT PARTS LIST (Continued)

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
N15	949-040447-002	Resistor Network, Decay Lower (R1,R2,R4 thru R8)*	1
N16	949-040448-001	Resistor Network, Attack (R1,R3,R8)*	1
N17	949-040449-002	Resistor Network, Sustain (R1,R3,R5,R7,R8)*	1
N18	949-040319-001	Resistor Network, Preset Voltage Divider (R87 thru R96)*	1
N19	949-040320-001	Resistor Network, Reference Supply Divider (R70,R72,R74,R76, R79)*	1
P111	910-040314-036	Header, Printed Circuit, MR, 36 Pin, AMP9-350276-1	1
P112,P115	910-040299-009	Header, Printed Circuit, Keyed 9 Pin, (0.1 Centers), AMP640098-9 . .	2
P113	910-040299-008	Header, Printed Circuit, 8 Pin, (0.1 Centers), AMP640098-8.	1
P114	910-040299-005	Header, Printed Circuit, 5 Pin, (0.1 Centers), AMP640098-5	1
P116	910-040299-006	Header, Printed Circuit, 6 Pin, (0.1 Centers), AMP640098-6	1
P117	910-040299-010	Header, Printed Circuit, 10 Pin, (0.1 Centers), AMP640098-0	1
P118	910-040299-007	Header, Printed Circuit, Keyed, 7 Pin (0.1 Centers), AMP640098-7 . .	1
Q1	991-041049-001	Transistor, NPN, TIP29	1
Q2	991-041050-001	Transistor, PNP, TIP30	1
R1,R23,R26, R29,R31,R36, R40,R44,R45	852-312181-001	Resistor, 180 Ohm, ± 5%, 1/4W	9
R2,R24,R25, R27,R28,R30, R43,R46,R59, R63, R65 thru R69	852-312102-001	Resistor, 1K Ohm, ± 5%, 1/4W	16
R3,R4,R33, R34,R57,R58, R73,R98	852-312104-001	Resistor, 100K Ohm, ± 5%, 1/4W	8
R6,R12, R14,R22	852-312273-001	Resistor, 27K Ohm, ± 5%, 1/4W	4
R10	852-312623-001	Resistor, 62K Ohm, ± 5%, 1/4W	1
R8,R16	852-312363-001	Resistor, 36K Ohm, ± 5%, 1/4W	2
R18,R20,R32, R48	852-312153-001	Resistor, 15K Ohm, ± 5%, 1/4W	4
R35	852-312513-001	Resistor, 51K Ohm, ± 5%, 1/4W	1
R37,R38,R39, R41, R83 thru R86	852-312223-001	Resistor, 22K Ohm, ± 5%, 1/4W	8
R50,R52,R54	852-312333-001	Resistor, 33K Ohm, ± 5%, 1/4W	3
R56	852-312154-001	Resistor, 150K Ohm, ± 5%, 1/4W	1
R60	852-312221-001	Resistor, 220 Ohm, ± 5%, 1/4W	1
R61	852-312391-001	Resistor, 390 Ohm, ± 5%, 1/4W	1
R62	852-312473-001	Resistor, 47K Ohm, ± 5%, 1/4W	1
R71	925-040266-007	Resistor, Trim Cermet, 500 Ohm.	1
		* See Schematic Diagram for Resistor Values (± 5%, 1/4W)	

TABLE 7-6

POLYMOOG RIGHT HAND CONTROL AND MASTER PRESET PRINTED CIRCUIT CR BOARD 11 ASSEMBLY
REPLACEMENT PARTS LIST (Continued)

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
R75	925-040266-001	Resistor, Trim Cermet, 10K Ohm	1
R77	852-312270-001	Resistor, 27 Ohm, ± 5%, 1/4W	1
R78,R81	852-312103-001	Resistor, 10K Ohm, ± 5%, 1/4W	2
R80	924-040187-001	Resistor, 16 Ohm, ± 5%, 5W	1
R97	852-312100-001	Resistor, 10 Ohm, ± 5%, 1/4W	1
SW1,SW16	960-040222-001	Switch, Pushbutton, White, VAR	2
SW2,SW17	960-040224-007	Switch, Pushbutton, Gray, PRE	2
SW3,SW12	960-040224-010	Switch, Pushbutton, Gray, ON	2
SW4,SW13	960-040224-011	Switch, Pushbutton, Gray, OFF	2
SW5,SW10	960-040224-012	Switch, Pushbutton, Gray, UPPER	2
SW6,SW11	960-040224-013	Switch, Pushbutton, Gray, LOWER	2
SW7,SW9	960-040224-014	Switch, Pushbutton, Gray, ALL	2
SW8	960-040224-015	Switch, Pushbutton, Gray, SPLIT	1
SW14	960-040224-008	Switch, Pushbutton, Gray, LOCK	1
SW15	960-040224-016	Switch, Pushbutton, Gray, MAN	1
	902-042525-001	Nut, Speed, No. 6 Type W, Tinnerman, C224-6Z-4	2
	816-040039-006	Screw, Self Tapping, No. 6 x 3/8 in., Type B	2
	906-040307-010	Socket, 10 Pin, SIL, AMP1-583773-3	16
	906-040307-007	Socket, 7 Pin, SIL, AMP1-583773-4.	32
	910-040311-001	Pin, 0.058, AMP 60973-1	35
	906-040307-008	Socket, 8 Pin, SIL, AMP1-583773-5.	2

7.9 POLYMOOG MODE SELECTOR CONTROL CIRCUIT DESCRIPTION (BOARD 12)

The mode selector control circuit board (PRE) is mounted behind the front panel extrusion and contains eight preset pushbuttons, a No. 9 pushbutton which is the variable mode, a cancel PART/FULL "." pushbutton, a numeric decorder/divider and a numeric readout. (Refer to Volume II.)

When one of preset switches SW1 thru SW9 or PART/FULL "." switch is depressed, the respective SP control line to the right control board is connected to ground. This causes a binary coded version of the switch number to be stored in a latch circuit and returned to the mode selector control via the IDLA-D lines which drive numeric decoder/divider IC1. This decoder/divider drives numeric readout L1 via resistors R1 thru R8. Approximately 30 milliamperes are supplied to each selected segment in the seven segment numeric readout.

TABLE 7-7
POLYMOOG MODE SELECTOR PANEL PRINTED CIRCUIT CR BOARD 12 ASSEMBLY REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-040161-001	Mode Selector Panel Printed Circuit Board Assembly, consisting of:	
IC1	991-041097-001	Integrated Circuit, SN7447A	1
L1	939-040824-001	Light Emitting Diode, Digital, 7 Segment, DL747	1
R1 thru R8	852-312750-001	Resistor, 75 Ohm, ±5%, 1/4W	8
SW1	960-040223-001	Switch, Pushbutton, Blue, 1	1
SW2	960-040223-002	Switch, Pushbutton, Blue, 2	1
SW3	960-040223-003	Switch, Pushbutton, Blue, 3	1
SW4	960-040223-004	Switch, Pushbutton, Blue, 4	1
SW5	960-040223-005	Switch, Pushbutton, Blue, 5	1
SW6	960-040223-006	Switch, Pushbutton, Blue, 6	1
SW7	960-040223-007	Switch, Pushbutton, Blue, 7	1
SW8	960-040223-008	Switch, Pushbutton, Blue, 8	1
SW9	960-040223-009	Switch, Pushbutton, Blue, 9	1
SW10	960-040223-010	Switch, Pushbutton, Blue, 10	1

7.10 MODE SELECTOR CONTROL BOARD REMOVAL

a. Remove the right and left control boards from the front panel extrusion.

b. Remove four Phillips head screws at the corners of the mode selector board and unplug connector between the right control board and mode selector board and remove board.

7.11 POLYMOOG KEYBOARD MASTER VOICE SELECTOR (BOARD 12)

The MASTER VOICE SELECTOR board is mounted behind the center front panel and contains a series of preset circuit buttons numbered one through fourteen. Each button is identified on the front panel as to the type of sound produced such as STRING, PIANO and so forth. A circuit description of the board follows supplemented by Table 7-8.

IC1 on board 12 is an 8 line to 3 line encoder which converts its decimal input to binary on its A, B, and C outputs. Depressing any one of the fourteen preset buttons causes IC1 to transfer the binary code to its A, B, and C outputs and forces the EO output to a logical 1 (positive). It is important to note that IC1 does not have the capability to store or retain data; therefore, correct data is only displayed while a preset button is being held.

IC2, C1, C2, R2 and R3 comprise a one-shot that develops a delayed 10 usec negative going (at pin 13) and a positive going (at pin 8) pulse every time the IC1 EO output goes high. The delay before the one-shot pulse and the EO output going high is caused by the EO output not being a direct pull-up for C1. CR3 is back biased by the EO output going high; therefore, C1's only source of charge current comes from IC2's input current. The delay time will be equal to the time it takes C1 to charge enough to exceed the threshold of IC2. Since IC2 has Schmitt inputs it will respond predictably to slow moving input voltages.

IC3 is a quad bistable latch which transfers data from its inputs to its outputs when its clock input is high. When IC3's clock input returns to a logical 0, data that was present on its inputs at the time of the transition is retained on its outputs until another clock pulse is received. The one-shot positive going delayed pulse from the IC2 described above is used to supply the clock pulse to IC3. The delay in the one-shot is required to insure enough set-up time for IC3 (time before clock pulse is received and the data preset on the inputs). If this delay were not employed, IC3 would receive data on its inputs and a clock pulse at virtually the same time which could cause dropped or missing pieces of data.

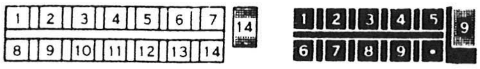


TABLE 7-8 TRUTH TABLE

PRESET BUTTON PRESSED	IC3 OUTPUT (ACTIVE LOW)				LATCH OUTPUTS		IC6 INPUTS (ACTIVE HIGH)				UNITS READ-OUTS L1 NO. 1	10'S READ-OUTS L1 NO. 2	Q2 COLLECTOR	BOARD OUTPUTS TO S93				
	D	C	B	A	IC4D	IC4C	D	C	B	A				D	D	C	B	A
1	H	H	H	L	L	H	L	L	L	H	1	B	H	L	H	L	L	H
2	H	H	L	H	L	H	L	L	H	L	2	B	H	L	H	L	H	L
3	H	H	L	L	L	H	L	L	H	H	3	B	H	L	H	L	H	H
4	H	L	H	H	L	H	L	H	L	L	4	B	H	L	H	H	L	L
5	H	L	H	L	L	H	L	H	L	H	5	B	H	L	H	H	L	H
6	H	L	L	H	L	H	L	H	H	L	6	B	H	L	H	H	H	L
7	H	H	L	L	L	H	L	H	H	H	7	B	H	L	H	H	H	H
8	H	H	H	H	H	L	H	L	L	L	8	B	H	H	L	H	H	L
9	H	H	H	L	H	L	H	L	L	H	9	B	H	H	L	H	H	H
10	L	H	H	H	L	H	L	L	L	L	0	1	L	H	L	L	L	L
11	L	H	H	L	L	H	L	L	L	H	1	1	L	H	L	L	L	H
12	L	H	L	H	L	H	L	L	H	L	2	1	L	H	L	H	H	L
13	L	H	L	L	L	H	L	L	H	H	3	1	L	H	L	H	H	H
14	L	L	H	H	L	H	L	H	H	L	4	1	L	H	L	L	L	L

NOTES

1. L — Ground (OV.)
2. H — Positive (3.5V to 5V)
3. B — Blank
4. Active Low — A low level state will be read as a binary 1 and a high level state will be read as a binary 0.
5. Active High — A low level state will be read as a binary 0 and a high level state will be read as a binary 1.

Summarizing the preceding paragraphs:

a. Preset button depressed.

b. IC1 converts the applied input data to binary on its A, B, and C outputs.

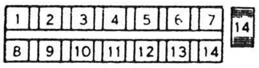
c. IC1 EO output starts the delay which fires the IC2 one-shot.

d. IC2 one-shot transfers the data present at the IC3 inputs to its outputs.

e. Upon the return of the IC3 clock input to a logical 0 binary, coded data is now retained at the IC3 outputs.

Since IC1 only has a 3 bit capacity (can only encode numbers from 0 to 7) more data is needed for presets higher than 7.

Preset button 8 is coupled by means of CR2 to the 0 input of IC1 which will transfer a 0 code (which is the first 3 lower order bits of an 8 code) on the output of IC1 when depressed.



Both preset buttons 8 and 9 are diode OR'ed, via CR5 and CR6, and coupled through a delay circuit comprised of R4, R5, and C3 to one input of a cross-coupled latch consisting of IC4 C and D, R6, and R7. The other input of this cross-coupled latch is driven by the IC2 negative going one-shot pulse. The action of this latch is as follows:

Depressing any preset button causes the IC2 one-shot to fire (as described earlier) which sets IC4D pin 11 to a logical 0 and IC4C pin 8 to a logical 1; however, if preset button 8 or 9 is depressed, pin 13 of IC4D will be forced to a logical 0 (through diode OR and delay circuit), therefore, before the preset button can be released, the one-shot pulse will have returned to a logical 1. This action reverses the output status of the latch.

Summarizing the IC4C and D latch function:

a. For all presets except 8 or 9, IC4D pin 11 will be set to a logical 0 and IC4C pin 8 at a logical 1.

b. For presets 8 or 9, IC4D pin 11 will be set to a logical 1 and IC4C pin 8 at a logical 0. Preset buttons 10 through 14, rather than having their common side tied to ground (as is the case for buttons 1 through 9), are connected through the base emitter junction of Q1 to ground. Note that the base emitter junction drop of Q1 does not affect the operation of the IC1 input (IC1 input functions the same as if presets 10 through 14 were tied to ground). Depressing any preset button from 10 to 14 causes input current from IC1 to flow through the depressed button and through the base emitter junction of Q1, turning Q1 on and pulling its collector to ground (logical 0). There is now a piece of data which tells us whenever a preset button from 10 to 14 is depressed. This data is applied to and retained at IC3 in the same manner as the data from IC1 as described earlier.

Preset buttons 10 through 14 are also connected to the 0 through 4 inputs of IC1 respectively (preset button 10 to IC1 input 0 and so forth). From this information, notice that IC1, with the exception of presets 8 and 9, will transfer the binary code for the units digit of the preset depressed. For instance, depressing preset 2 will produce a 2 code on the IC1 output, depressing preset 12 will produce a 2 code, depressing preset 13 will produce a 3 code and so forth. Presets 8 and 9 are exceptions because they require an additional bit (IC1 has only 3 output lines and presets 8 and 9 require 4). The first 3 bits are transferred by IC1 and the remaining bit (highest order of "8" line) is stored at the IC4C and D latch as described above.

Summarizing the data stored:

a. IC3 A, B, and C outputs retain data in binary for the units digit of the preset, except only the 3 lowest order bits for presets 8 or 9.

b. IC4C and D latch retains the highest order ("8" line) bit data for presets 8 and 9 (combining this data with data from IC1 output will yield the complete code for presets 8 and 9).

c. IC3D output is a logical 0 for presets 10 through 14 and a logical 1 for presets 1 through 9.

IC6 is a seven segment decoder and driver which converts the binary coded information on its inputs to the proper logic levels to drive the units readout (L1 No. 1). As described above, the complete binary data for the units digit is contained at the IC3 A, B, and C outputs and the IC4C and D latch output. Because IC6 has active high inputs, its A, B, and C inputs are driven from the $\overline{A}$, $\overline{B}$, and $\overline{C}$ outputs of IC3 which follow the logic levels of the A, B, and C outputs only inverted. There is now all the data required to display the units digit.

The tens digit (L1 No. 2) is driven by Q2 whose base is tied to the $\overline{D}$ output of IC3. As described earlier, the D output of IC3 (which is simply the inversion of $\overline{D}$) will be at a logical 0 (ground) for presets 10 through 14, making $\overline{D}$ a logical 1 (positive), therefore, turning Q2 on displays a 1 for the units digit.

The four outputs from IC5 follow the data at the A, B, and C, and D outputs of IC3 only inverted with the exception of presets 8 and 9 where the pin 8, 3 and 6 outputs are forced to a logical 1. This was done to avoid codes being sent to board 9 which would result in inaccurate preset decoding. IC4A and B gates are open collector OR'ed and develop the logic status as indicated in the attached truth table.

Not previously mentioned in this description is the purpose of the delay circuit consisting of R4, R5, and C3. The digital circuit would function correctly without this delay, but slowing down this switching function helps reduce clicks from coupling into the audio output.

The RP1 output is used on the LEFT HAND CONTROL board to return various switching functions to their preset state whenever a preset button is depressed.

The SQUELCH output follows the EO output from IC1 through diode CR4 and is used on board 9 to suppress switching transitions from showing up in the audio output as clicks.

TABLE 7-9

POLYMOOG KEYBOARD MASTER VOICE SELECTOR PRINTED CIRCUIT MODE BOARD 12 ASSEMBLY REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-042507-001	Printed Circuit Board Assembly, consisting of:	
C1,C3	946-040231-011	Capacitor, Tantalum, 6.8uf, 6V	2
C2	947-040200-103	Capacitor, Disc, 0.01uf	1
C4	946-040231-001	Capacitor, Tantalum, 1.5uf, 20V	1
R1 thru CR6	919-041075-001	Diode, 1N4148, Alternate 1N914	6
IC1	991-041106-001	Integrated Circuit, 74148	1
IC2	991-041095-001	Integrated Circuit, SN7413	1
IC3	991-041100-001	Integrated Circuit, SN7475	1
IC4,IC5	991-041096-001	Integrated Circuit, SN7426	2
IC6	991-041097-001	Integrated Circuit, SN7447	1
L1	939-042633-001	LED, Segment Digital, (1-1/2 Digit), MAN 6630	1
Q1,Q2	991-041051-001	Transistor, NPN, 2N3904	2
R1 thru R4, R6,R7,R8,R16	852-312102-001	Resistor, 1K Ohm, ± 5%, 1/4W	8
R5	852-312181-001	Resistor, 180 Ohm, ± 5%, 1/4W	1
R9 thru R15, R18,R19	852-312151-001	Resistor, 150 Ohm, ± 5%, 1/4W	9
R17	852-312202-001	Resistor, 2K Ohm, ± 5%, 1/4W	1
SW1	960-040223-001	Switch, Pushbutton, Blue 1	1
SW2	960-040223-002	Switch, Pushbutton, Blue 2	1
SW3	960-040223-003	Switch, Pushbutton, Blue 3	1
SW4	960-040223-004	Switch, Pushbutton, Blue 4	1
SW5	960-040223-005	Switch, Pushbutton, Blue 5	1
SW6	960-040223-006	Switch, Pushbutton, Blue 6	1
SW7	960-040223-007	Switch, Pushbutton, Blue 7	1
SW8	960-040223-008	Switch, Pushbutton, Blue 8	1
SW9	960-040223-009	Switch, Pushbutton, Blue 9	1
SW10	960-040223-011	Switch, Pushbutton, Blue 10	1
SW11	960-040223-012	Switch, Pushbutton, Blue 11	1
SW12	960-040223-013	Switch, Pushbutton, Blue 12	1
SW13	960-040223-014	Switch, Pushbutton, Blue 13	1
SW14	960-040223-015	Switch, Pushbutton, Blue 14	1

SECTION 8
BOARD 13
POWER SUPPLY

8.1 POWER SUPPLY SUBASSEMBLY CIRCUIT DESCRIPTION - IDENTIFIED WITH MOOG LOGO ON PRINTED CIRCUIT BOARD

The Moog power supply is used on Polymoog Synthesizers above serial numbers 3200 (approximately) and on all Polymoog Keyboard units. Primary power is applied through P101, ON-OFF switch S102, 115-230V selector switch S101 and fuses F101 and F102 to power transformer T1. (Refer to Volume II.) The power transformer is designed with two identical 115 VAC primary windings connected in parallel or series, depending on the position of selector switch S101, to allow either 115 or 230 VAC operation. Each of the three independent output windings of T1 is applied to a full wave bridge rectifier and regulator circuit to provide regulated -15, +15 and +5 VDC outputs. The output of each bridge rectifier is filtered by an electrolytic capacitor having a bleeder resistor connected in parallel to remove any residual charge when power is removed from the unit.

The heart of each regulator section is comprised of a 723 integrated circuit consisting of four basic sections; a temperature compensated voltage reference, operational amplifier, current limiter and current amplifier (see Figure 8-1). The voltage reference section of the +15 and +5 VDC supplies produces a stable +7.15 ± 0.36 VDC output at pin 6 which may be used at that level or divided down. The operational amplifier section is used as a linear amplifier to compare a direct or divided reference voltage applied to pin 5 with a divided sample of the power supply output voltage applied to pin 4. The current amplifier section amplifies the small current obtained from the output of the operational amplifier section and is used as an emitter follower to drive external transistors from pin 10. The current limiter section, when connected to external circuitry, acts to limit or reduce the current available to the current amplifier section should a power supply current overload occur.

The output from each bridge rectifier and filter is a considerably higher voltage than the regulated output voltage. Transistors Q1, Q3, Q5 and Q6 are emitter followers acting as electronically variable resistors controlled by the current applied to their bases. Transistors Q2, Q4 and Q7 operate as current amplifiers driving Q1, Q3, Q5 and Q6. The +7.15 VDC voltage reference from pin 6 of the 723 IC is applied to pin 5 (through a divider resistor on the +5 VDC supply) which is the noninverting input to the operational amplifier section of the IC. A voltage divider between the positive sensing terminal and the negative sensing terminal applies a voltage proportional to the output voltage into the inverting input (pin 4) of the operational amplifier to be compared with the reference voltage applied to pin 5. If the output voltage is too high, the voltage at pin 4 will be higher than the voltage at pin 5. This reduces the current into the base of the driver transistor in turn reducing the current into the base of the pass transistor causing the output voltage to drop to the correct level. If the output voltage is too low, the opposite action occurs.

Two types of overcurrent protection provided include a constant current overload protection used on the + and -15 volt outputs and a foldback overload protection used on the +5 volt output. On the + and -15 volt outputs, resistors R6 and R17 are in series with the output. The current limit transistor in the 723 IC is connected to this resistor so that if the voltage drop of this resistor exceeds 0.6 volt due to excessive output current, this transistor conducts to prevent any further increase in the output current. When this point is reached, the output voltage will start to drop. The foldback overload protection used in the +5 volt section of the power supply operates by sensing both voltage and current. An overload is first sensed by the combined drop across the base-emitter junction of Q5 and the drop across R31. When the combined drop exceeds approximately 1.2 volts, the current limit transistor in the IC starts to conduct causing the output voltage to begin to drop. When this happens, the voltage drop across the divider becomes less causing the current limit to conduct even more. As a result of this regenerative action, the short circuited current of the power supply is much less than the rated full load current.

Variable resistors R8, R19 and R33 allow for individual adjustment of each output voltage. Resistors R10, R21 and R35 and diodes CR6 and CR13

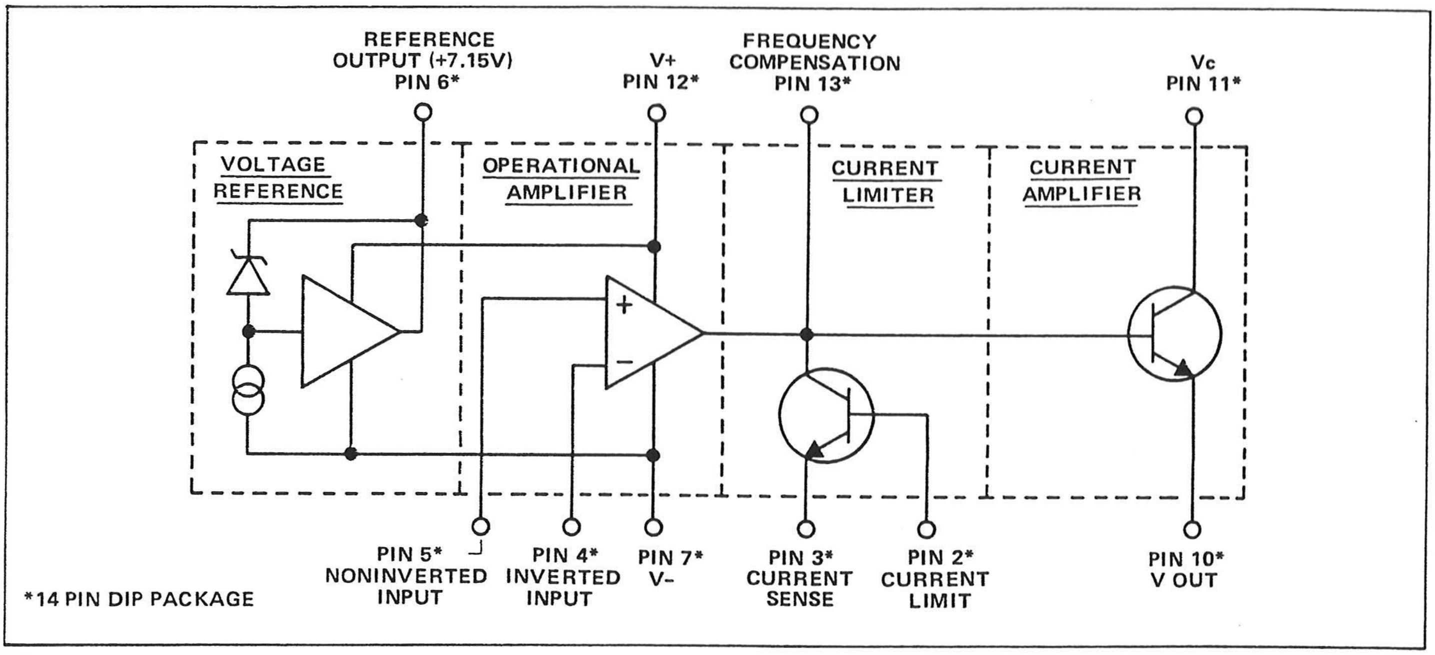


FIGURE 8-1 MOOG VOLTAGE REGULATOR INTEGRATED CIRCUIT (723 DIP PACKAGE)

prevent the outputs from rising to excessive levels should one of the sensing leads accidentally become disconnected. Diodes CR7, CR14 and CR20 across each output protect its output from accidental application of a reversed voltage to its output terminals. Capacitors C3, C6 and C9 provide a low dynamic impedance for each output.

8.2 POWER SUPPLY SUBASSEMBLY CIRCUIT DESCRIPTION – IDENTIFIED WITH FARATRON LOGO (Serial Numbers Below Approximately 3677)

Primary power is applied through P101, ON-OFF switch S102, 115-230V selector switch S101 and fuses F101 and F102 to power transformer T601. (Refer to Volume II). The power transformer is designed with two identical 115 VAC primary windings connected in parallel or series, depending on the position of selector switch S101, to allow either 115 or 230 VAC operation. Each of the three independent output windings of T601 is applied to a full wave bridge rectifier and regulator circuit to provide regulated -15, +15 and +5 VDC outputs. The output of each bridge rectifier is filtered by an electrolytic capacitor having a bleeder resistor connected in parallel to remove any residual charge when power is removed from the unit.

The heart of each regulator section is comprised of a 723 integrated circuit consisting of four basic sections; a temperature compensated voltage reference, operational amplifier, current limiter and current amplifier (see Figure 8-2). The voltage reference section of the +15 and +5 VDC supplies produces a stable +7.15 ±0.36 VDC output at pin 4 which may be used at that level or divided down. The operational amplifier section is used as a linear amplifier to compare a direct or divided reference voltage applied to pin 3 with a divided sample of the power supply output voltage applied to pin 2. The current amplifier section amplifies the small current obtained from the output of the operational amplifier section and is used as an emitter follower to drive external transistors from pin 6. The current limiter section, when connected to external circuitry, acts to limit or reduce the current available to the current amplifier section should a power supply current overload occur.

The output from each bridge rectifier and filter is a considerably higher voltage than the regulated output voltage. Transistors Q1, Q4, Q7 and Q8 are emitter followers acting as electronically variable resistors controlled by the current applied to their bases. Transistors Q2, Q5 and Q9 operate as current amplifiers driving Q1, Q4, Q7 and Q8. The +7.15 VDC voltage reference from pin 4 of the 723 IC is applied to pin 3 (through a divider resistor on the +5 VDC supply) which is the noninverting input to the operational amplifier section of the IC. A voltage divider between the positive sensing terminal and the negative sensing terminal applies a voltage proportional to the output voltage into the inverting input (pin 2) of the operational amplifier to be compared with the reference voltage applied to pin 3. If the output voltage is too high, the voltage at pin 2 will be higher than the voltage at pin 3. This reduces the current into the base of the driver transistor in turn reducing the current into the base of the pass transistor causing the output voltage to drop to the correct level. If the output voltage is too low, the opposite action occurs.

Two types of overcurrent protection provided include a constant current overload protection used on the + and -15 volt outputs and a foldback overload protection used on the +5 volt output. On the + and -15 volt outputs, resistors R3 and R14 are in series with the output. The current limit transistor in the 723 IC is connected to this resistor so that if the voltage drop of this resistor exceeds 0.6 volt due to excessive output current, this transistor conducts to prevent any further increase in the output current. When this point is reached, the output voltage will start to drop. The foldback overload protection used in the +5 volt section of the power supply operates by sensing both voltage and current. An overload is first sensed by the combined drop across the base-emitter junction of Q7 and the drop across R27. When the combined drop exceeds approximately 1.2 volts, the current limit transistor in the IC starts to conduct causing the output voltage to begin to drop. When this happens, the voltage drop across the divider becomes less causing the current limit to conduct even more. As a result of this regenerative action, the short circuited current of the power supply is much less than the rated full load current.

Variable resistors R8, R19 and R33 allow for individual adjustment of each output voltage. Resistors R6, R17 and R18 and diodes CR19 and CR20 prevent the outputs from rising to excessive levels should one of the sensing leads accidentally become disconnected. Diodes CR6, CR12 and CR18 across each output protect its output from accidental application of a reversed voltage to its output terminals. Capacitors C3, C6 and C9 provide a low dynamic impedance for each output.

8.3 POWER SUPPLY SUBASSEMBLY GENERAL SERVICING AND ADJUSTMENT

The -15, +15 and +5 VDC outputs of the power supply subassembly must be checked first and adjusted to their nominal values within 10 millivolts if necessary prior to any equipment servicing (refer to Table 8-1). The most common anticipated problems related to the power supply subassembly are open rectifier diodes and transistors.

8.4 POWER SUPPLY SUBASSEMBLY REMOVAL

a. If it is necessary to remove a component, unplug the 15-pin main power supply connector from the top of the board and three connectors located at the bottom of the board with blue, gray and green wires.

b. Remove three black Phillips head screws which pass through the heat coupling plate at the bottom of the supply board into the rear panel extrusion.

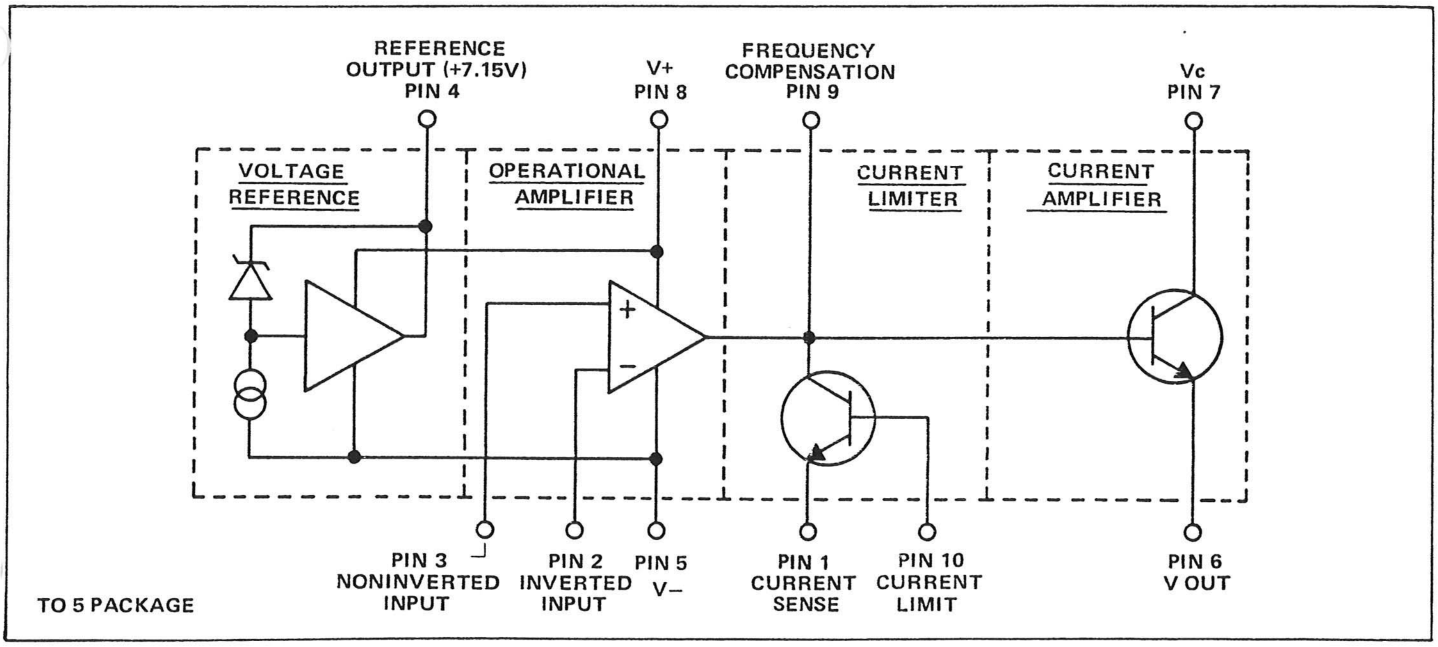


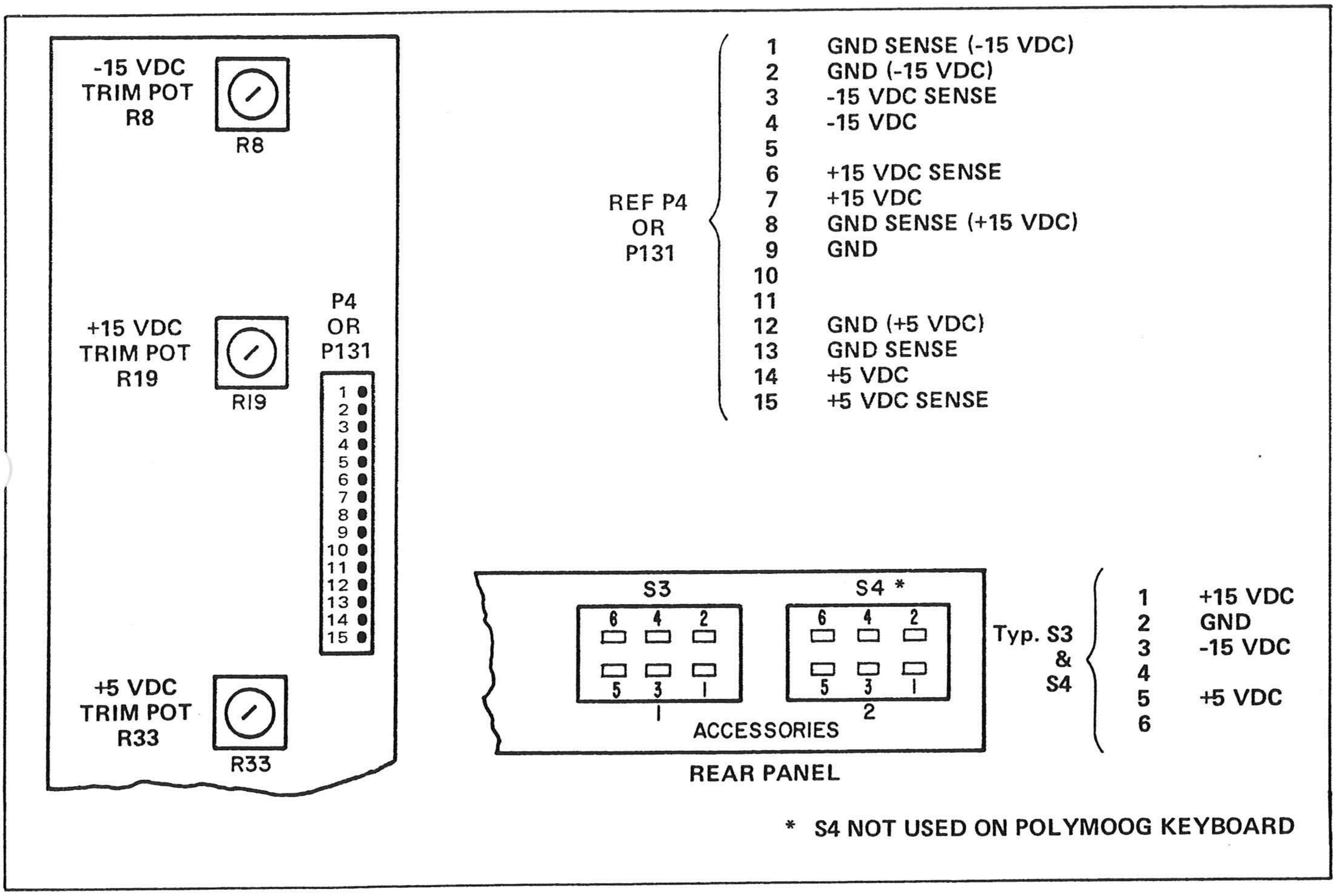
FIGURE 8-2 VOLTAGE REGULATOR INTEGRATED CIRCUIT - FARATRON SUPPLY

c. Remove four nuts on screws attached to standoffs at the top of the board and pull board slightly forward and up out of the unit.

> **CAUTION**
> Extreme caution must be used when remounting the power supply board as it is very important to insure no particles are trapped between the heat coupler plate mounted to the board and the rear panel extrusion. Even very small particles can prevent proper heat transfer from the heat coupler plate to the extrusion.

8.5 POWER SUPPLY SUBASSEMBLY TROUBLESHOOTING

Troubleshoot the power supply subassembly using Tables 8-2 or 8-3, the circuit description, (paragraphs 8.1 or 8.2) and part location and schematic diagrams in Volume II. Note that voltage levels displayed on the schematic diagrams are not absolute values as readings may vary between units. Once the problem is localized, check the suspected part by direct substitution if possible. Otherwise use a voltmeter or oscilloscope to determine the malfunctioning part. Note the color code on the power supply schematics. This is for +15V and +5V parts and is used throughout the instrument harnessing.



-15 VDC TRIM POT R8
R8
+15 VDC TRIM POT R19
RI9
+5 VDC TRIM POT R33
R33
P4 OR P131
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
REF P4 OR P131
1 GND SENSE (-15 VDC)
2 GND (-15 VDC)
3 -15 VDC SENSE
4 -15 VDC
5
6 +15 VDC SENSE
7 +15 VDC
8 GND SENSE (+15 VDC)
9 GND
10
11
12 GND (+5 VDC)
13 GND SENSE
14 +5 VDC
15 +5 VDC SENSE
S3
S4 *
6 4 2
5 3 1
1
2
ACCESSORIES
REAR PANEL
Typ. S3 & S4
1 +15 VDC
2 GND
3 -15 VDC
4
5 +5 VDC
6
* S4 NOT USED ON POLYMOOG KEYBOARD

FIGURE 8-3 POWER SUPPLY ASSEMBLY ADJUSTMENT CONTROLS AND OUTPUTS

TABLE 8-1

POLYMOOG AND POLYMOOG KEYBOARD POWER SUPPLY VOLTAGE ADJUSTMENT AND TROUBLESHOOTING

STEP	TEST AND ADJUSTMENT	CORRECTIVE ACTION
1	Apply primary power to Polymoog and connect digital voltmeter negative test lead to pin 2 of accessory connector on rear panel and positive test lead to pin 1. Observe digital voltmeter and adjust +15 VDC trim pot R19 on power supply assembly for +15 VDC ± 10 mv. See Figure 8-3.	If proper voltage is present, proceed to step 2. If output voltage is not present or cannot be adjusted, disconnect power supply output connector and measure voltage between pins 7 (+) and 9 (–). If present, perform step 4. If not present, trouble is in power supply assembly. Refer to Tables 8-2 and 8-3.
2	Reconnect positive test lead to pin 5 of accessory connector. Observe digital voltmeter and adjust +5 VDC trim pot R33 on power supply assembly for +5 VDC ± 10 mv.	If proper voltage is present, proceed to step 3. If output voltage is not present or cannot be adjusted, disconnect power supply output connector and measure voltage between pins 14 (+) and 12 (–). If present, perform step 4. If not present, trouble is in power supply assembly.
3	Reconnect positive test lead to pin 2 and negative test lead to pin 3 of accessory connector. Observe digital voltmeter and adjust –15 VDC trim pot R8 on power supply assembly for –15 VDC ± 10 mv.	If proper voltage is present, power supply assembly is operating properly. If output voltage is not present or cannot be adjusted, disconnect power supply output connector and measure voltage between pins 4 (–) and 2 (+). If present, perform step 4. If not present, trouble is in power supply assembly.
4	Reconnect power supply output connector and digital voltmeter test leads to pins on accessory connector where proper voltage was not available. **CAUTION:** If power supply failed by going out of regulation causing high voltages to be applied throughout the instrument, there are voltage suppressors on the Left Hand Control (CL) and Right Hand Control (CR) printed circuit boards that will short. These are 15 kilowatt Zener diodes identified as CP1 (Circuit Protector 1) on the CR board and CP1 through CP3 on the CL board. These devices must be replaced if shorted. If the instrument is operated without the circuit protectors in place, severe damage to the associated semiconductors and integrated circuits (CMOS, TTL) could result.	Monitor digital voltmeter and sequentially disconnect power supply input connectors on TR. (P91), TC (P88), TL (P71), MBL (P41 and P42), MBM (P51 and P52), MBH (P61 and P62) and DIV (P325) printed circuit boards until voltage indication appears (shorted board located). Troubleshoot or repair board as outlined in its applicable section. If voltage indication still is not present, trouble is in CL (P107), Mode (P112) or CR (P111) Polymoog printed circuit boards or cable harness. If no voltage indication is present on Polymoog Keyboard, trouble is in CLP1010 or Master Voice Keyboard P106 printed circuit boards or wiring harness.

TABLE 8-2
MOOG POWER SUPPLY SUBASSEMBLY TROUBLESHOOTING

PROBLEM	PROBABLE DEFECTIVE COMPONENT
Loss of all output voltages	Power source, P101, S101, S102, F101, F102 and T1
Loss of -15V output voltage	Voltage buss external to power supply shorted to common, P132, CR1 thru CR4, Q1, Q2, IC1, R8, P131 and C3
Voltage at pin 6 of IC1 is not -7.85 ±0.39V or voltage at pin 10 is less than +1.62V	IC1, C1, R2 thru R4, R6 and R10
Loss of -15V output adjustment	R10, R7 thru R9
Excessive -15V output voltage, no voltage control	Q1, Q2 and IC1
Voltage at pin 7 of IC1 is not -7.85 ±0.39V or voltage at pin 4 is higher than at pin 7	IC1 and C2
Low -15V output voltage	CR1 thru CR4, instrument wiring shorted
Loss of +15V output voltage	Voltage buss external to power supply shorted to common, P133, CR8 thru CR11, Q3, Q4, IC2, R19, P131 and C6
Voltage at pin 6 of IC2 is not +7.15 ±0.36V or voltage at pin 10 is less than +16.7V	IC2, C4, R13 thru R15, R17, R21, CR12 and C6
Loss of +15V output adjustment	R18 thru R21
Excessive +15V output voltage, no voltage control	Q3, Q4 and IC2
Voltage at pin 7 of IC2 is not +7.15 ±0.36V or voltage at pin 4 is higher than at pin 7	IC2 and C5
Low +15V output voltage	CR8 thru CR11, instrument wiring shorted
Loss of +5V output voltage	Voltage buss external to power supply shorted to common, P3, CR15 thru CR18, Q5 thru Q7, IC3, R33, P4 and C9
Voltage at pin 6 of IC3 is not +7.15 ±0.36V or voltage at pin 10 is less than +7.32V	IC3, C7, R35, R24 thru R28, R30, R31, CR19 and C9
Loss of +5V output adjustment	R33 thru R35
Excessive +5V output voltage, no voltage control	Q5 thru Q7 and IC3
Voltage at pin 7 of IC3 is not +4.53 ±0.23V or voltage at pin 4 is higher than at pin 7	IC3 and C8
Low +5V output voltage	CR15 thru CR18, instrument wiring shorted

TABLE 8-3
FARATRON POWER SUPPLY SUBASSEMBLY TROUBLESHOOTING

PROBLEM	PROBABLE DEFECTIVE COMPONENT
Loss of all output voltages	Power source, P101, S101, S102, F101, F102, T601
Loss of -15V output voltage	Voltage buss external to power supply shorted to common, P1, CR1 thru CR4, Q1 thru Q3, R8, P4, C3
Voltage at pin 4 of Q3 is not -7.85 ±0.39V or voltage at pin 6 is less than +1.62V	Q3, C1, R2 thru R6, CR5, C3
Loss of -15V output adjustment	R6, R8 thru R10
Excessive -15V output voltage, no voltage control	Q1 thru Q3
Voltage at pin 3 of Q3 is not -7.85 ±0.39V or voltage at pin 2 is higher than at pin 3	Q3, C2
Low -15V output voltage	CR1 thru CR4, instrument wiring shorted
Loss of +15V output voltage	Voltage buss external to power supply shorted to common, P2, CR7 thru CR10, Q4 thru Q6, R19, P4, C6
Voltage at pin 4 of Q6 is not +7.15 ±0.36V or voltage at pin 6 is less than +16.7V	Q6, C4, R13 thru R17, CR11, C6
Loss of +15V output adjustment	R17, R19 thru R21
Excessive +15V output voltage, no voltage control	Q4 thru Q6
Voltage at pin 3 of Q6 is not +7.15 ±0.36V or voltage at pin 2 is higher than at pin 3	Q6, C5
Low +15V output voltage	CR7 thru CR10, instrument wiring shorted
Loss of +5V output voltage	Voltage buss external to power supply shorted to common, P3, CR13 thru CR16, Q7 thru Q10, R33, P4, C9
Voltage at pin 4 of Q10 is not +7.15 ±0.36V or voltage at pin 6 is less than +7.32V	Q10, C7, R18, R24 thru R30, CR17, C9
Loss of +5V output adjustment	R18, R33, R34

TABLE 8-3
FARATRON POWER SUPPLY SUBASSEMBLY TROUBLESHOOTING (Continued)

PROBLEM	PROBABLE DEFECTIVE COMPONENT
Excessive +5V output voltage, no voltage control	Q7 thru Q10
Voltage at pin 3 of Q10 is not +4.53 ±0.23V or voltage at pin 2 is higher than at pin 3	Q10, C8
Low +5V output voltage	CR13 thru CR16, instrument wiring shorted

TABLE 8-4
POLYMOOG REAR PANEL SUBASSEMBLY
REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	994-040347-001	Controls Base Wire Assembly, consisting of:	
	997-040348-001	Control Subassembly, consisting of:	1
	905-040498-002	Pop Rivet, Black, 1/8 Dia.	8
	915-040273-001	Knob, 1/4 Dia. Bore	1
	806-023239-006	Screw, FH, 4-40 x 3/8 lg.	2
	904-040495-015	Lock Washer, No. 4	2
	801-023221-000	Nut, No. 4-40	2
	904-012864-000	Flat Washer, 3/8	18
	904-040495-021	Lock Washer, 3/8	18
	902-042026-001	Nut, 3/8 - 32	19
	997-040182-001	Rear Panel Subassembly (Faratron)	1
	997-042671-001	Rear Panel Subassembly (Moog)	1
	902-040500-004	Speed Nut, 10A "TIN'N"	4
	913-040325-001	Overlay, Controls, Vinyl, Pressure Sensitive	1
	996-040689-104	Capacitor, 0.10uf	1
J1,J2,J5,J13	910-041632-001	Receptacle, Phone, 2 Circuit with NC Switch, 0.206 Dia.	4
J3,J4,J6 thru J9,J11,J14 thru J17	910-041306-001	Phone Jack, 1 Circuit	11
J10	910-041306-008	Phone Jack, 2 Circuit with NO Switch	1
J12	910-041306-009	Phone Jack, 2 Circuit, Shorting	1
P1	910-041697-002	Panel Plug, 2 Conductor	1
R1	925-042731-002	Variable Resistor, 10K Ohms	1
S1	910-041696-002	Panel Socket, 2 Conductor	1
S2	910-041451-001	Phone Receptacle	1
S3,S4	910-041707-006	Panel Socket, 6 Conductor	2

TABLE 8-5
POLYMOOG POWER SUPPLY REPLACEMENT PARTS LIST

REF DESIG OR INDEX NO.	PART NUMBER	DESCRIPTION	QTY
	997-042671-001	Power Supply Subassembly consisting of:	
	806-065132-006	Screw, 10-32 x 3/8 in., Pan Hd.	4
	811-040039-008	Screw, Self Tapping, 6A x 1/2 in.	3
	902-040500-001	Speed Nut, No. 6A	2
	902-040500-003	Speed Nut, No. 10, Tinnerman	4
	902-040199-006	Fastener, Self Clinching, PEM S-632-2	3
	903-040489-055	Screw, 6-32 x 5/8 in., Black	5
	903-042674-002	Screw, 4-40 x 3/8 in., Pan Hd., Taptite	4
	903-042674-009	Screw, 6-32 x 3/8 in.	3
	904-041390-015	Washer, Flat, No. 4	2
	904-040495-016	Washer, Lock, No. 6	5
	904-042729-001	Washer, Shoulder, Insulated	4
	905-040498-034	Rivet, Pop, Black, 1/8 in. dia.	8
	906-041331-002	Fuse Holder, Dual.	1
	908-042730-001	Insulator, Mica.	4
	911-040189-001	Lug, Terminal, No. 6	1
	913-040326-001	Overlay, Power Supply	1
	913-040841-001	Label, Service Caution	1
	913-042088-004	Label, Fuse, 3/4A Slo-Blo	1
	913-042673-001	Label, Caution, Heat Sink	1
	968-040255-002	Extrusion, Rear	1
	968-042619-001	Heat Sink	1
	969-040667-001	Shield	1
	973-042672-001	Insert, Standoff, Special, PEM Y2277-ZB	2
F101,F102	939-041620-005	Fuse, 3/4 Amp., 250V, 3AG, Slo-Blo	2
P101	910-041739-001	Receptacle, AC250V/6A	1
Q1,Q3,Q5,Q6	991-042663-001	Transistor, TIP41, NPN	4
T1	954-041961-001	Transformer	1
S101	960-041303-001	Switch, Selector, 115/230V	1
S102	960-041755-001	Switch, Rocker, Black	1

TABLE 8-6
MOOG POWER SUPPLY PRINTED CIRCUIT PS BOARD 13 ASSEMBLY
REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-042670-001	Power Supply Printed Circuit Board Assembly (33441 PN 50887), consisting of:	
C1,C4	945-040209-011	Capacitor, Aluminum Electrolytic, 1000uf, 35V	2
C2,C5,C8	947-042020-471	Capacitor, Disc, 470pf, 1KV, Alt. 500pf, 50V	3
C3,C6,C9	945-040209-007	Capacitor, Aluminum Electrolytic, 470uf, 35V	3
C7	945-040209-037	Capacitor, Aluminum Electrolytic, 4700uf, 16V	1
CR1 thru CR4, CR6 thru CR11,CR13, CR14,CR20	919-042019-001	Diode, Rectifier, 1N4004	13
CR5,CR12, CR19	919-041255-002	Diode, Zener, 22 Volt, 1W, IN4748A	3
CR15 thru CR18	919-041157-001	Diode, Rectifier, MR502, Alternate GE A15B	4
IC1 thru IC3	991-041484-001	Integrated Circuit, Regulator 723CE	3
P131	910-042533-015	Header, 15 Pin, Non-Locking, (0.156 Centers), AMP1-640444-5 . . .	1
P132 thru P134	910-042531-003	Header, 3 Pin, Locking, (0.156 Centers), AMP1-640445-3	3
Q2,Q4,Q7	991-041056-001	Transistor, MPSU05	3
R1,R12	852-512332-001	Resistor, 3.3K Ohm, ±5%, 1/2W	2
R2,R10,R13, R21,R24	852-512471-001	Resistor, 470 Ohm, ±5%, 1/2W	5
R3,R14,R27	852-312102-001	Resistor, 1K Ohm, ±5%, 1/4W	3
R4,R15, R28,R30	852-312101-001	Resistor, 100 Ohm, ±5%, 1/4W	4
R5,R16,R29	852-312681-001	Resistor, 680 Ohm, ±5%, 1/4W	3
R6,R17	923-041258-006	Resistor, 0.68 Ohm, ±5%, 2W	2
R7,R9,R18, R20,R26	853-424991-031	Resistor, 4.99K Ohm, ±1%, 1/4W	5
R8,R19,R33	925-042526-001	Resistor, Variable, 1K Ohm	3
R11,R22,R23	852-312152-001	Resistor, 1.5K Ohm, ±5%, 1/4W	3
R25	853-422491-031	Resistor, 2.49K Ohm, ±1%, 1/4W	1
R31	924-041258-001	Resistor, 0.33 Ohm, ±5%, 2W	1
R32	852-312472-001	Resistor, 4.7K Ohm, ±5%, 1/4W	1
R34	853-427151-031	Resistor, 7.15K Ohm, ±1%, 1/4W	1
R35	852-312391-001	Resistor, 390 Ohm, ±5%, 1/4W	1
R36	852-312471-001	Resistor, 470 Ohm, ±5%, 1/4W	1
	906-040307-007	Socket, Integrated Circuit, 7 Pin, SIL, AMP1-583773-4	6
	902-040942-003	Nut Insert, 6-32, PEM KF2-632	2
	906-042676-001	Socket, Transistor, Molex 10-18-2031	4
	911-042030-006	Pin, Tube	1

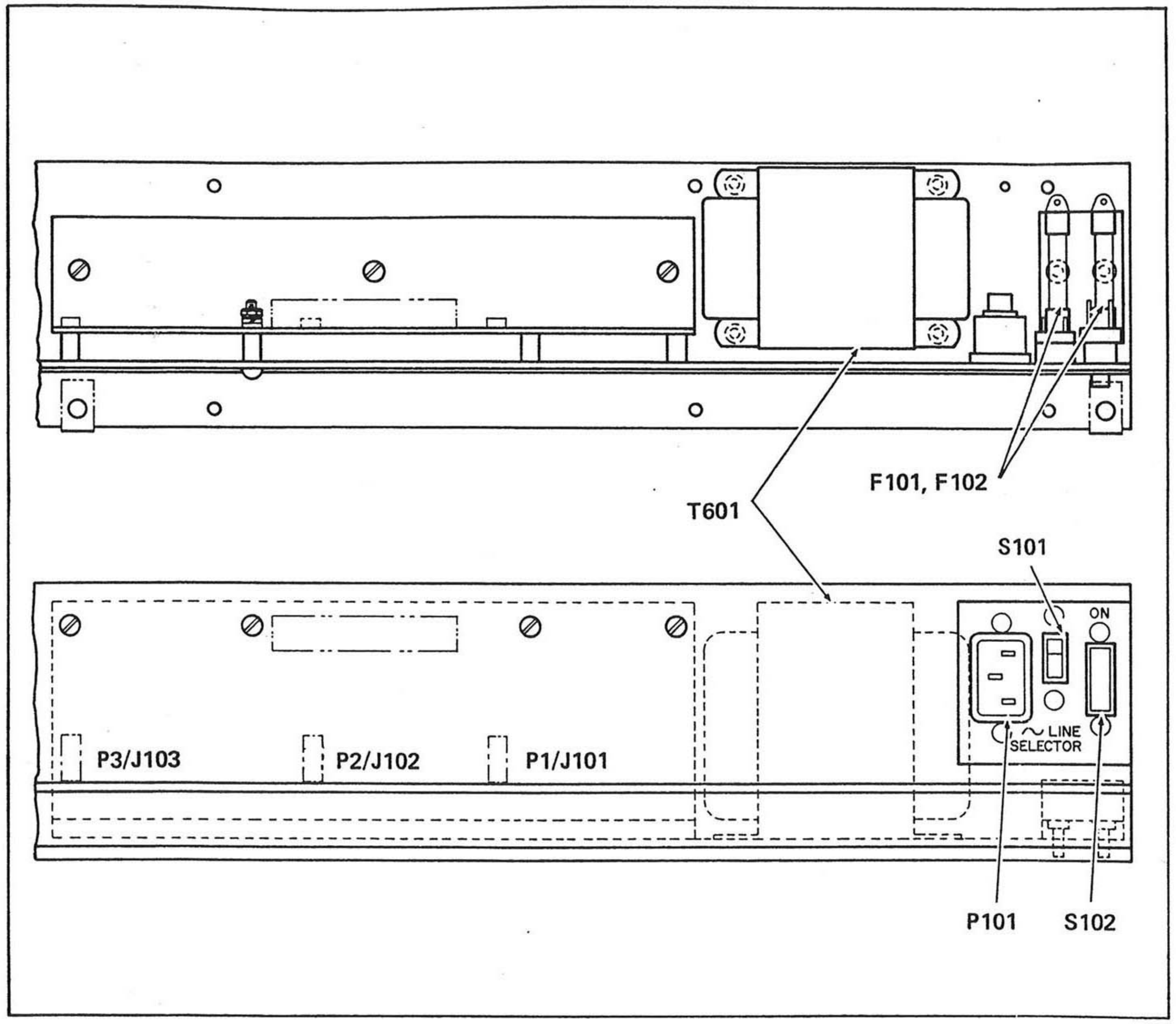
TABLE 8-7
FARATRON POWER SUPPLY PRINTED CIRCUIT PS BOARD 13 ASSEMBLY REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	996-041695-001	Power Supply Printed Circuit Board Assembly (33441 PN 50887), consisting of:	
C1,C4	945-040209-011	Capacitor, Electrolytic, 1000uf, 35V	2
C2,C5,C8	947-040202-501	Capacitor, Disc, 470pf, 1KV, Alternate 500pf, 50V	3
C3,C6,C9	945-040209-007	Capacitor, Electrolytic, 500uf, 25V, Alternate 470uf, 35V	3
C7	945-040209-037	Capacitor, Electrolytic, 4700uf, 15V	1
CR1 thru CR4, CR6 thru CR10,CR12, CR18 thru CR20	919-042019-001	Diode, Rectifier, 1N4002, Alternate 1N4004	13
CR5,CR11, CR17	919-041480-001	Diode, Zener, 1R22B, 22 Volt	3
CR13 thru CR16	919-041481-001	Diode, Rectifier, 1N5400	4
P1 thru P3	910-041719-003	Connector, 3 Pin, Molex 09-65-1031	3
P4	910-041528-015	Connector, 15 Pin, Molex A5004-15A	1
Q1,Q4,Q7,Q8	991-041482-001	Transistor, 2N5494	4
Q2,Q5,Q9	991-041483-001	Transistor, 2N3053	3
Q3,Q6,Q10	991-041484-001	Integrated Circuit, Regulator, 723 CE in TO5 Cans	3
R1,R12	852-512332-001	Resistor, 3.3K Ohm, ± 5%, 1/2W	2
R2,R6,R13, R17,R24	852-512471-001	Resistor, 470 Ohm, ± 5%, 1/2W	5
R3,R14	923-041485-001	Resistor, 0.68 Ohm, ± 5%, 2W	2
R4,R15, R28,R29	852-312101-001	Resistor, 100 Ohm, ± 5%, 1/4W	4
R5,R16,R30	852-312102-001	Resistor, 1K Ohm, ± 5%, 1/4W	3
R8,R19,R33	949-041487-001	Resistor, Variable, 2K Ohm, Indiv. Alternate 925-041486-001 ...	3
R9,R20	Part of 949-041487-001, R8, R19	Resistor, 6.81K Ohm, ± 1%, Indiv. Alternate 853-426811-031 ...	Ref
R10,R21,R34	Part of 949-041487-001, R8,R19,R33	Resistor, 7.15K Ohm, ± 1%, Indiv. Alternate 853-427151-031 ...	Ref
R11,R22,R23	852-312152-001	Resistor, 1.5K Ohm, ± 5%, 1/4W	3
R18	852-312391-001	Resistor, 390 Ohm, ± 5%, 1/4W	1
R25	Part of 949-041487-001, R33	Resistor, 2.61K Ohm, ± 1%, Indiv. Alternate 853-422611-031 ...	Ref
R26	Part of 949-041487-001, R33	Resistor, 4.32K Ohm, ± 1%, Indiv. Alternate 853-424321-031 ...	Ref
R27	924-041485-002	Resistor, 0.33 Ohm, ± 10%, 2W	1
R31	852-312681-001	Resistor, 680 Ohm, ± 5%, 1/4W	1
R32	852-312472-001	Resistor, 4.7K Ohm, ± 5%, 1/4W	1
R35	852-312471-001	Resistor, 470 Ohm, ± 5%, 1/4W	1

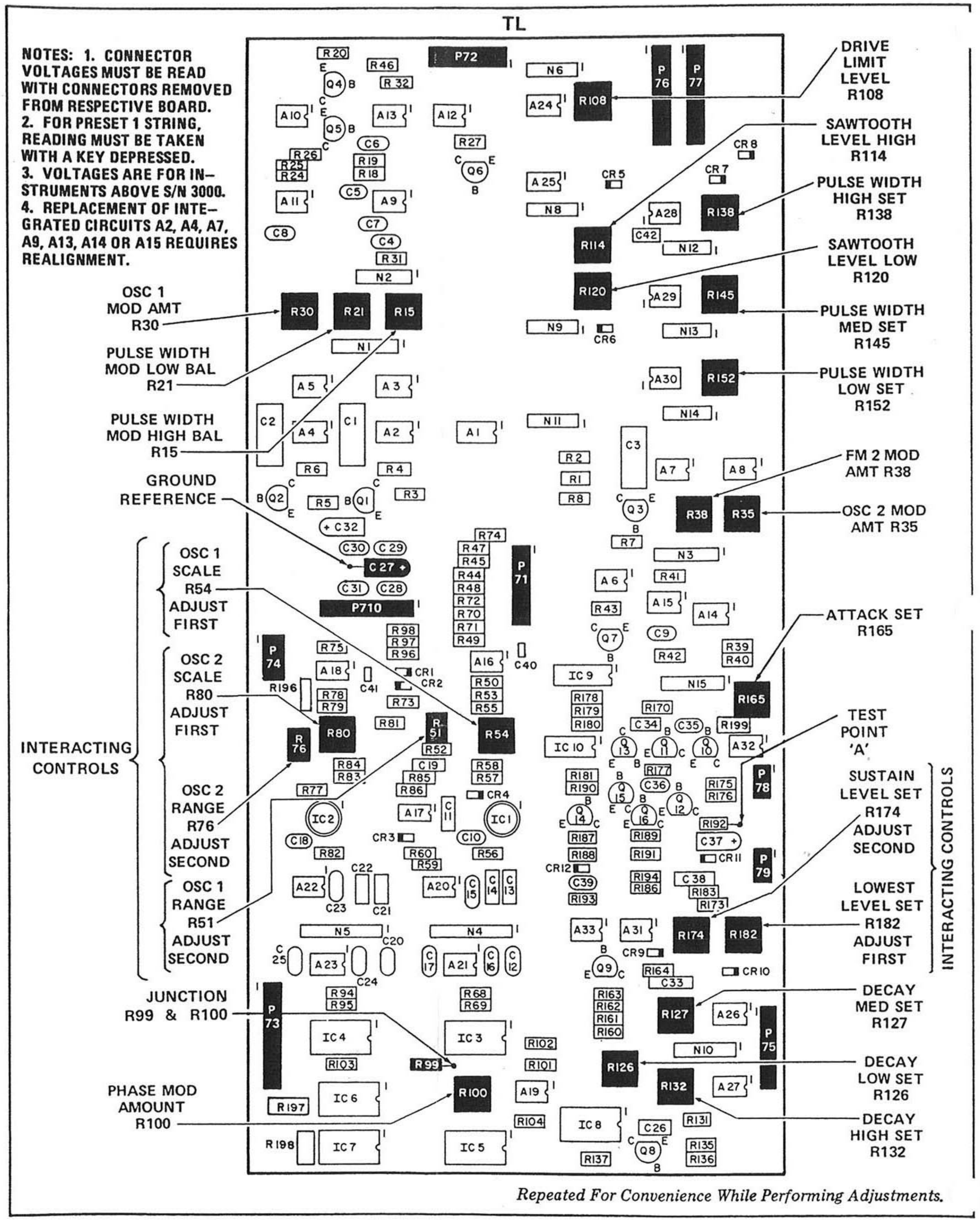
TABLE 8-8
FARATRON REAR PANEL SUBASSEMBLY
REPLACEMENT PARTS LIST

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	997-040182-001	Power Supply Subassembly, consisting of:	
	806-045039-008	Screw, No. 6-32 x 1/2 lg.	3
	904-040495-016	Lock Washer, No. 6	7
	902-040199-006	Fastener, Self-Clinching, PEM No. S-632-2	3
	996-041695-001	Power Supply Printed Circuit Board Assembly	1
	806-065132-006	Screw, No. 10-32 x 3/8 lg.	4
	902-040500-005	Speed Nut, No. 8A	4
	976-041619-001	Fuse Holder, Dual (XF101 and XF102)	1
	905-040498-002	Pop Rivet, Black, 1/8 Dia.	8
	903-040489-068	Screw, NI, No. 6-32 x 3/4 lg.	4
	904-041390-017	Flat Washer, No. 6	4
	973-040508-059	Spacer, No. 6-32 x 3/8 lg.	4
	902-041394-009	Hex Nut, No. 6	4
	968-040255-001	Rear Extrusion	1
	910-041720-003	Insert, Connector, Molex 08-50-0105	6
	913-040326-001	Overlay, Power Supply	1
	957-041794-001	Line Cord	1
F101,F102	939-041620-005	Fuse, Slow Blow, 3/4 Amp, 3AG.	2
J101 thru J103	910-041718-003	Connector, 3 Pin, Molex 09-50-3031	3
P101	910-041739-001	Receptacle, AC, 250V/6 Amp	1
S101	960-041303-001	Selector Switch, 115/230V.	1
S102	960-041755-001	Switch, Rocker, Black, DPDT	1
T601	954-041961-001	Transformer, TR50864	1

QTY
3
7
3
1
4
4
1
8
4
4
4
4
1
6
1
1
2
3
1
1
1
1


T601
F101, F102
S101
ON
~ LINE SELECTOR
P3/J103
P2/J102
P1/J101
P101
S102

POWER SUPPLY SUBASSEMBLY



NOTES: 1. CONNECTOR VOLTAGES MUST BE READ WITH CONNECTORS REMOVED FROM RESPECTIVE BOARD.
2. FOR PRESET 1 STRING, READING MUST BE TAKEN WITH A KEY DEPRESSED.
3. VOLTAGES ARE FOR INSTRUMENTS ABOVE S/N 3000.
4. REPLACEMENT OF INTEGRATED CIRCUITS A2, A4, A7, A9, A13, A14 OR A15 REQUIRES REALIGNMENT.

TL
OSC 1 MOD AMT R30
PULSE WIDTH MOD LOW BAL R21
PULSE WIDTH MOD HIGH BAL R15
GROUND REFERENCE
INTERACTING CONTROLS
OSC 1 SCALE R54 ADJUST FIRST
OSC 2 SCALE R80 ADJUST FIRST
OSC 2 RANGE R76 ADJUST SECOND
OSC 1 RANGE R51 ADJUST SECOND
JUNCTION R99 & R100
PHASE MOD AMOUNT R100
DRIVE LIMIT LEVEL R108
SAWTOOTH LEVEL HIGH R114
PULSE WIDTH HIGH SET R138
SAWTOOTH LEVEL LOW R120
PULSE WIDTH MED SET R145
PULSE WIDTH LOW SET R152
FM 2 MOD AMT R38
OSC 2 MOD AMT R35
ATTACK SET R165
TEST POINT 'A'
SUSTAIN LEVEL SET R174 ADJUST SECOND
LOWEST LEVEL SET R182 ADJUST FIRST
INTERACTING CONTROLS
DECAY MED SET R127
DECAY LOW SET R126
DECAY HIGH SET R132
P72
P76
P77
P71
P710
P74
P73
P78
P79
P75
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC8
IC9
IC10

Repeated For Convenience While Performing Adjustments.

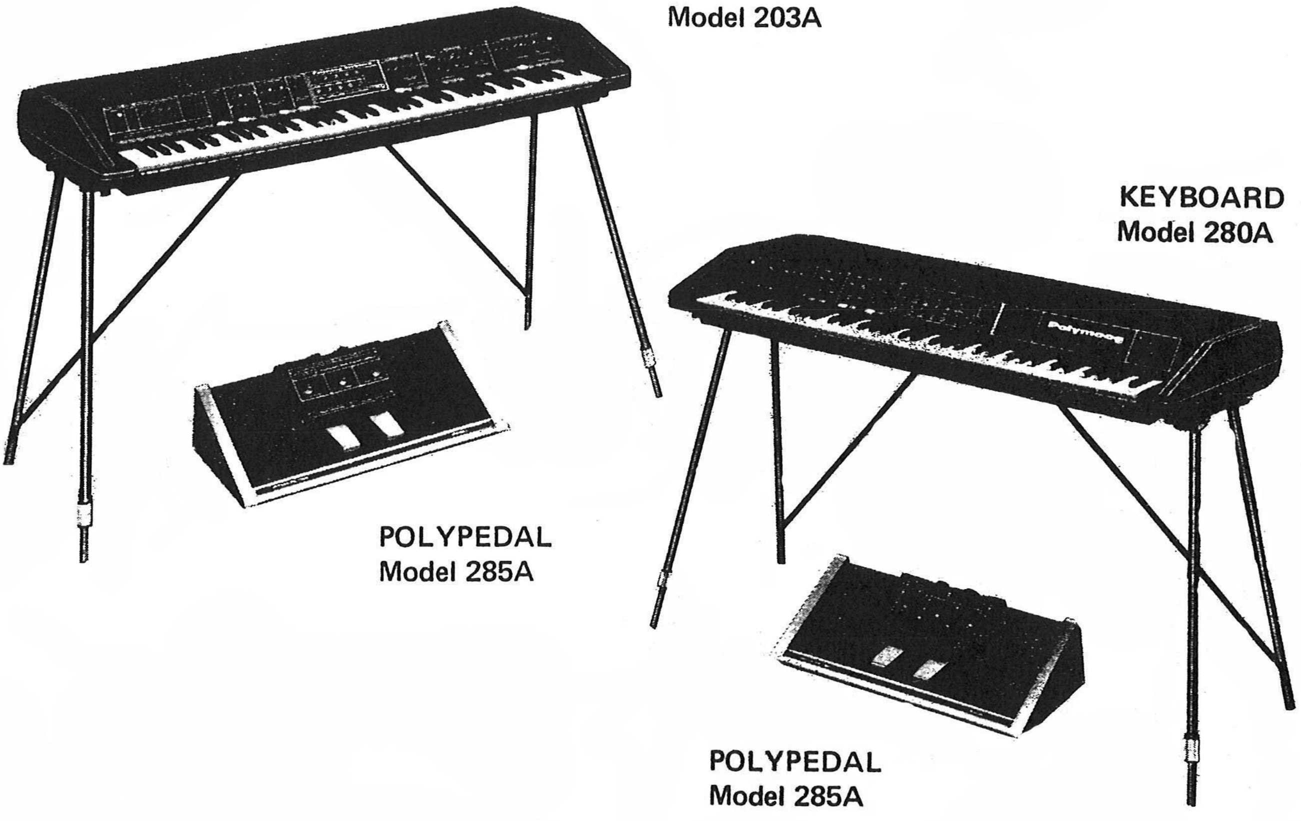
REFERENCE AND MODULATION OSCILLATOR WAVESHAPE AND KEYBOARD CONTROL PRINTED CIRCUIT BOARD ASSEMBLY

VOLUME II

MANUAL NO. 993-042314-004

TECHNICAL
SERVICE MANUAL
for

POLYMOOG
SYNTHESIZER AND
KEYBOARD



SYNTHESIZER
Model 203A

KEYBOARD
Model 280A

POLYPEDAL
Model 285A

POLYPEDAL
Model 285A

contents

TITLE	VOL. 1 SEC.	BOARD	SYNTH	KYBD	PAGE	TAB
Service Bulletins	N/A		X	X		GENERAL INFORMATION
Block Diagrams	N/A		X	X	1,2	
General Keyboard Schematic	1		X	X	3	
Rear Panels	1		X	X	4,5	
Polypedal	1		X	X	6-9	
Standard Noise Filter	N/A		X	X	10	
Noise Specifications	N/A		X	X	10-12	
Checkout Procedures	N/A		X	X	13,14	
High Frequency Oscillator (HFO)	2	1,2 Ver.1	X	X	15	HIGH FREQUENCY OSC., DIVIDER BOARDS 1, 2 & 3
High Frequency Oscillator (HFO)	2	1,2 Ver.2	X	X	16	
Divider Board (DIV)	2	3	X	X	17	
Low Mother Board (MBL)	3	4	X	X	19	MOTHER, MODULATOR, BALANCE BOARDS 4, 5 & 6
Medium Mother Board (MBM)	3	5	X	X	20	
High Mother Board (MBH)	3	6	X	X	21	
Modulator Card (MOD_n)	3		X	X	22	
Balance Card (BAL)	3		X	X	23	
Bypass Card (BY)	3		X	X	24	
Reference Oscillator (TL)	4	7	X	X	26,27	TOP BOARDS AND FILTERS 7, 8, 9 & 14
Voltage Controlled Filter (TR)	6	9	X		28,29	
Fixed and Variable Resonant Filters (TC)	5	8	X		30	
Filter No. 1 - String	5	Ver.1	X		31	
Filter No. 1 - String	5	Ver.2	X		32	
Filter No. 2 - Piano	5		X		33	
Filter No. 3 - Organ	5		X		34	
Filter No. 4 - Harpsichord	5		X		35	
Filter No. 5 - Funk	5		X		36	
Filter No. 6 - Clavinet	5		X		37	
Filter No. 7 - Vibes	5		X		38	
Filter No. 8 - Brass	5	Ver.1	X		39	
Filter No. 8 - Brass	5	Ver.2	X		40	
Audio Board (TC)	5	8		X	42	
Filter Board No. 1	5			X	43	
Filter Board No. 2	5			X	43	
Program Control Board (TR)	6	8		X	44,45	
Vox Humana (VOX)	5	14		X	46	
Left Hand Control Board (CL)	7	10	X		47	CONTROL BOARDS 10, 11 & 12
Right Hand Control Board (CR)	7	11	X		48,49	
Mode Selector Board (MODE)	7	12	X		50	
Left Hand Control Board (CL)	7	10		X	51	
Master Voice Selector (MODE)	7	12		X	52	
Power Supply (PS, Faratron)	8	13	X		53	POWER SUPPLY BOARD 13
Power Supply (PS, Moog)	8	13	X	X	54	

Norlin®
NORLIN MUSIC, INC.

Factory Service Bulletin

2500 WALDEN AVE. • BUFFALO, NEW YORK 14225 • UNITED STATES
51 NANTUCKET BLVD. • SCARBOROUGH, ONT. MIP 2N6 • CANADA
WAALHAVEN • Z.Z. 48 ROTTERDAM • THE NETHERLANDS

SUBJECT:
Polymoog Synthesizer Model 203A
Polymoog Keyboard Model 280A
Polypedal Model 285

NUMBER: 1207
DATE: 11/7

Supercedes:
M101, M101A, M102,
M102A, M103, 702
805, 806, 807, 808

This bulletin provides the procedures and information to update the Polymoog Synthesizer and Polymoog Keyboard to current manufacturing specifications. The information furnished relates to sound, reliability and improved performance.

The bulletin is structured to enable the service technician to quickly determine which modifications may be required to update an instrument. Each section is carefully documented and supported with a generous number of clarifying illustrations.

The updates basically fall into one of two categories. First are the preset voicing changes which apply only to Polymoog Synthesizers below serial number 3000. (Each authorized technician should become familiar with the differences in voicing to adequately describe the details of these changes to a prospective customer.) The second category is titled Reliability and Performance Improvement. This section is subdivided into smaller sections, each one covering a board or subassembly. Information common to both the Polymoog Synthesizer and Polymoog Keyboard appears first, followed by specific Synthesizer or Keyboard information. Symbols at the bottom of each page identify information pertaining to the Polymoog Synthesizer or Polymoog Keyboard or both. A serial number reference guide on the next page correlates the modifications and serial numbers.

Service guides and kit information are provided as a convenience at the end of this bulletin.

The Reliability and Performance Improvement Kit contains all parts necessary to update a Polymoog Synthesizer or Polymoog Keyboard. Service Centers may order complete updating kits and replenish parts from the kit as they are used.

Any Polymoog presented for service in the United States may be fully updated according to the Reliability and Performance Improvement modifications as long as the instrument is still in its warranty period. However, warranty consideration varies overseas, therefore check with your local distributor. It is estimated that complete updating may take 8 hours for a Polymoog Synthesizer, 4 hours for updating a Polymoog Keyboard and 1/2 hour for a Polypedal as outlined in this bulletin.

SERIAL NUMBER REFERENCE GUIDE

MODIFICATION	POLYMOOG SYNTHESIZER BELOW SERIAL NO.	POLYMOOG KEYBOARD BELOW SERIAL NO.	PAGE NO.
1. PRESET VOICING CHANGE	3000	N/A	1207-4
2. POWER SUPPLY (FARATRON)			
Thermal Coupling And Pass Transistor	3677	N/A	1207-9
CR20 Modification (MOOG POWER SUPPLY)	1750	N/A	1207-10
Protective Sleeving	As Needed	As Needed	1207-10
3. TOP LEFT BOARD 7			
Jitter	3823	1607	1207-11
Leaky Ribbon	Between 3677 and 3823	Between 1374 and 1607	1207-11
C13, C21	3727	1607	1207-11
Temperature Stability	3549	1475	1207-11
Reference Oscillator Stability	1655	N/A	1207-11
Phase Locked Loop	3677	1650	1207-11
Signal-to-Noise Upper 2 Octaves	3677	1650	1207-11
Prevent Component Shorting	3000	N/A	1207-11
Dynamics	1660	N/A	1207-14
4. HIGH FREQUENCY OSCILLATORS			
Version 1 - Prevent Chirps	3814	1693	1207-14
Static Protection	3300	N/A	1207-14
Reduce Hash	3000	N/A	1207-14
TOS Latchup	As Needed	As Needed	1207-14
Version 2 - Prevent Chirps	3677	1693	1207-14
5. BALANCE CARD			
Reduce Parasitics	3549	N/A	1207-16
6. TOP RIGHT BOARD NO. 9			
Contour Generator Temperature Stability	3750	N/A	1207-18
Eliminate Clicks	1600	N/A	1207-18
Brightness Oscillation	3549	N/A	1207-18
Keyboard and Sample and Hold Drift	3549	N/A	1207-18
Shield	3000 (Note Leveling Procedure Below 3600)		1207-18
S-Trig Harness	3000	N/A	1207-18
Keyboard CV Linearity	3000	N/A	1207-20
Sample and Hold Q5 Failure	1340	N/A	1207-20
Improve Triggering	3000	N/A	1207-20

SERIAL NUMBER REFERENCE GUIDE (Continued)

MODIFICATION	POLYMOOG SYNTHESIZER BELOW SERIAL NO.	POLYMOOG KEYBOARD BELOW SERIAL NO.	PAGE NO.
7. TOP CENTER BOARD 8			
Prevent Clicks and Pops	3549	N/A	1207-21
Noise Reduction	3000 (As Needed)	N/A	1207-22
8. LEFT HAND CONTROL BOARD 10			
Rank Tune	3000	N/A	1207-23
Pulse Width	3000	N/A	1207-23
9. RIGHT HAND CONTROL BOARD 11			
Static Protection	3300	N/A	1207-23
Sample and Hold Circuit Reliability	3000	N/A	1207-25
Sample and Hold (In Conjunction with Q5 Failure)	1340	N/A	1207-25
10. REAR PANEL Mix Out	3000	N/A	1207-25
Keyboard Scale Pot	3000	N/A	1207-26
11. STOP BAR INSTALLATION	3000	N/A	1207-26
12. MOD CARD BALANCING	3000	N/A	1207-27
13. REAR PANEL			
Static Protection	N/A	1156	1207-28
14. LEFT HAND CONTROL BOARD 10			
Static Protection	N/A	1156	1207-28
15. AUDIO BOARD 8			
Static Protection	N/A	1156	1207-28
Noise Reduction	N/A	1445	1207-28
Center and Decrease Range of R44 Trim	N/A	1445	1207-31
16. FILTER BOARD 1 RESPONSE CURVES			
Response Curves	N/A	1693	1207-31
Thump	N/A	1445	1207-31
17. PROGRAM CONTROL BOARD 9			
Intermittent Keyboard Oscillation	N/A	1445	1207-31
18. FRONT PANEL SUBASSEMBLY			
Shims	N/A	1720	1207-32
19. POLYPEDAL (Below S/N 1405)			
To Prevent Loss of Control	—	—	1207-32

MODIFICATION OF PRESET VOICING

These modifications level out the volume difference between preset voices on the DIRECT, MODE and VCF Outputs and also update the sound of the presets according to the latest market research as follows:

PRESET VOICE

Preset 1. Strings
MODE OUTPUT – has a fuller bass and the attack and decay time is decreased for more rapid playing styles. VCF OUTPUT – is swept with a slow modulation.

Preset 2. Piano
Has more even dynamics.

Preset 3. Organ
MODE OUTPUT – is less percussive with a slower attack. VCF OUTPUT – the contour sweeps the filter at a slow rate.

Preset 4. Harpsichord
MODE OUTPUT – has a fuller sound with increased bass response in the lower 2 octaves.

Preset 5. Funk
VCF OUTPUT has decreased emphasis which reduces background noise.

Preset 6. Clavinet
Unchanged.

Preset 7. Vibes
Unchanged.

Preset 8. Brass
VCF OUTPUT has less emphasis (WAH).

LOCATION: STRING FILTER PRINTED CIRCUIT BOARD 996-040352-001, (Version 1, Refer to Figure 1).
Change resistor R2 from 43K to 33K and label R3.
Change resistor R3 from 43K to a 0.001 capacitor and label C2.
Remove C2 (500 pf).
Add resistor R2, 82K Ohms from pin 1 to pin 6 of A1 (between newly labeled R3 and R4).

LOCATION: STRING FILTER PRINTED CIRCUIT BOARD 996-040352-001,(Version 2, Refer to Figure 2).
Change resistor R2 from 680K to 82K.

LOCATION: PIANO FILTER PRINTED CIRCUIT BOARD ASSEMBLY 996-040356-001, Refer to Figure 3.
Remove resistor R2, 10K.

LOCATION: ORGAN FILTER PRINTED CIRCUIT BOARD ASSEMBLY, 996-040360-001, Refer to Figure 3A.
Change R5 from 100K to 27K.

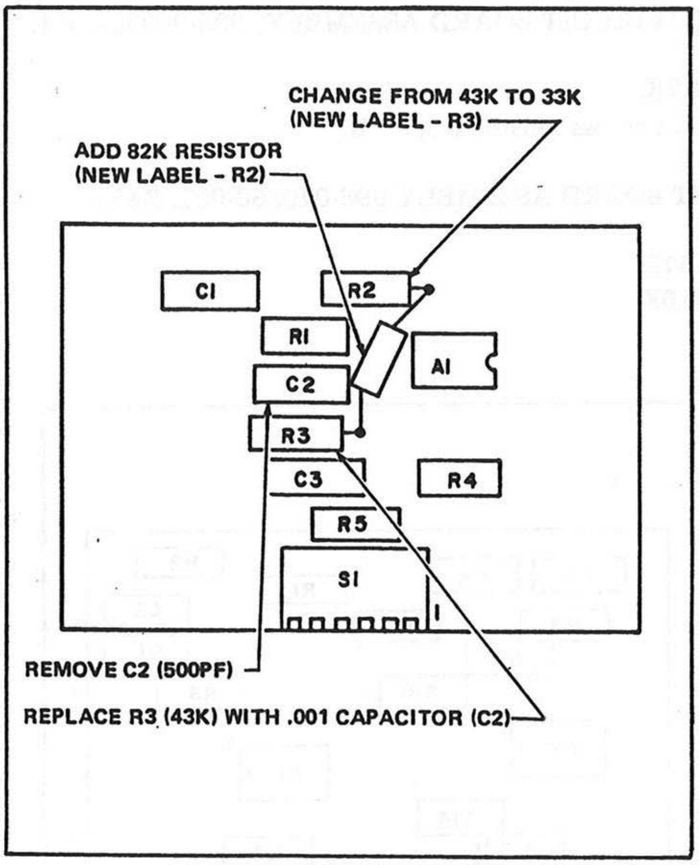

CHANGE FROM 43K TO 33K
(NEW LABEL - R3)
ADD 82K RESISTOR
(NEW LABEL - R2)
C1
R2
R1
A1
C2
R3
C3
R4
R5
S1
1
REMOVE C2 (500PF)
REPLACE R3 (43K) WITH .001 CAPACITOR (C2)

FIGURE 1 MODIFICATION OF STRING FILTER BOARD 1 (VERSION 1) (POLYMOOG)

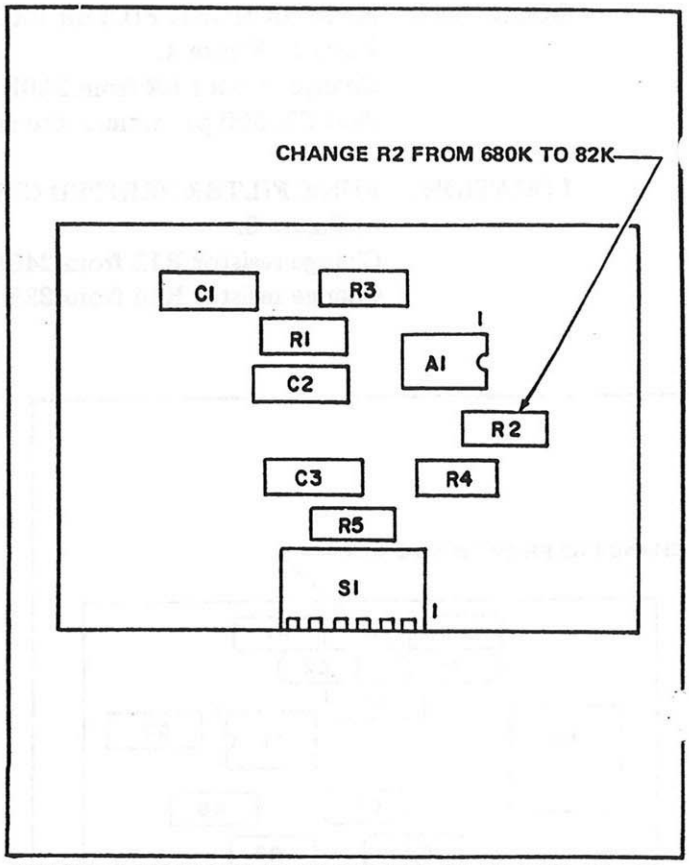

CHANGE R2 FROM 680K TO 82K
C1
R3
R1
1
A1
C2
R2
C3
R4
R5
S1
1

FIGURE 2 MODIFICATION OF STRING FILTER BOARD 1 (VERSION 2) (POLYMOOG)

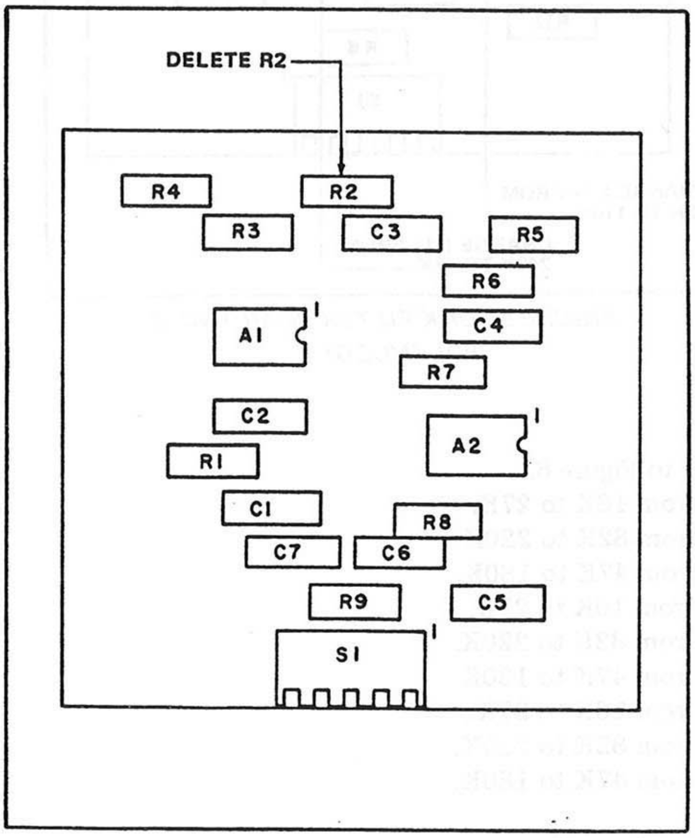

DELETE R2
R4
R2
R3
C3
R5
R6
A1
1
C4
R7
C2
A2
1
R1
C1
R8
C7
C6
R9
C5
S1
1

FIGURE 3 PIANO FILTER BOARD NO. 2 (POLYMOOG)

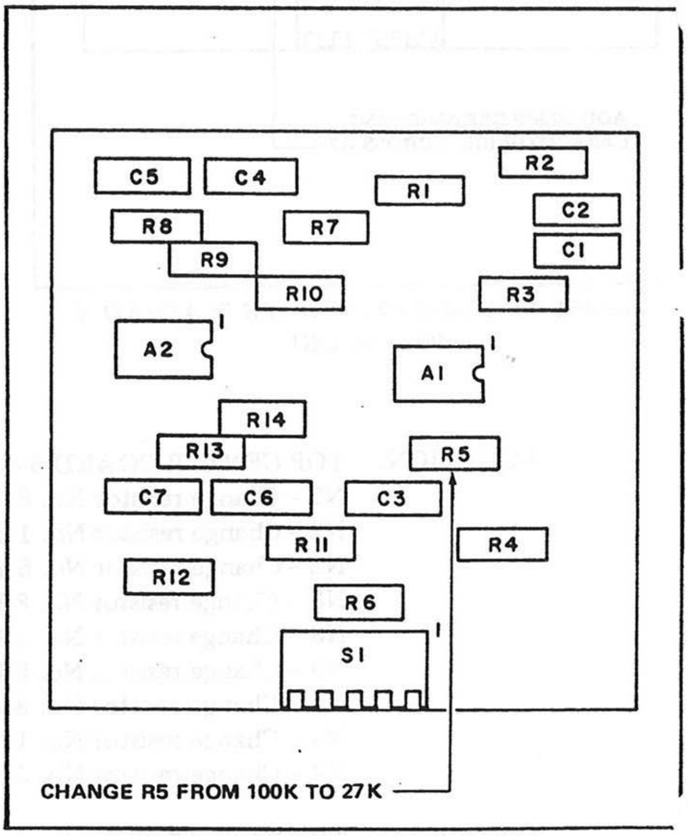

C5
C4
R2
R1
C2
R8
R7
R9
C1
R10
R3
A2
1
A1
1
R14
R13
R5
C7
C6
C3
R11
R4
R12
R6
S1
1
CHANGE R5 FROM 100K TO 27K

FIGURE 3A ORGAN FILTER BOARD NO. 4 (POLYMOOG)

LOCATION: HARPSICHORD FILTER PRINTED CIRCUIT BOARD ASSEMBLY, 996-040364-001, Refer to Figure 4.
Change resistor R2 from 220K to 4.7K.
Add C5, 500 pf ceramic disc capacitor across resistor R7, 47K.

LOCATION: FUNK FILTER PRINTED CIRCUIT BOARD ASSEMBLY 996-040366-001, Refer to Figure 5.
Change resistor R11 from 240K to 47K.
Change resistor R14 from 22K to 110K.

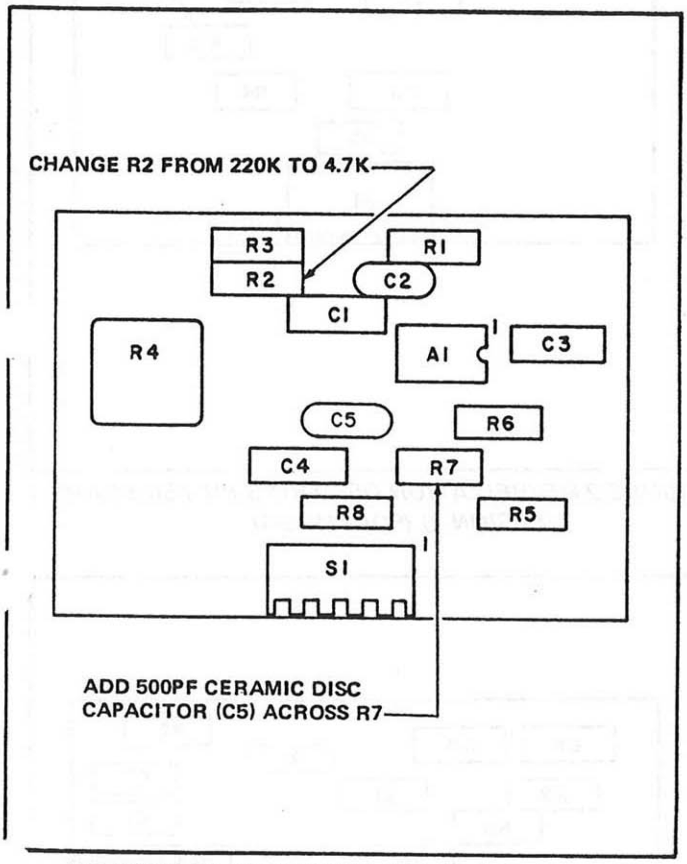

CHANGE R2 FROM 220K TO 4.7K
R3
R2
R1
C2
C1
R4
A1
1
C3
C5
R6
C4
R7
R8
R5
S1
1
ADD 500PF CERAMIC DISC CAPACITOR (C5) ACROSS R7

FIGURE 4 HARPSICHORD FILTER BOARD NO. 4 (POLYMOOG)

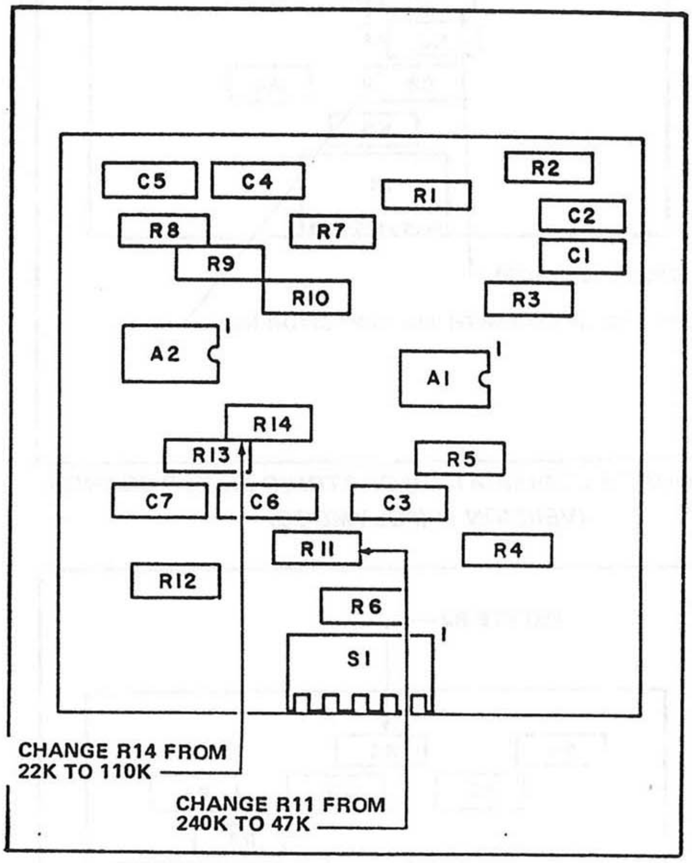
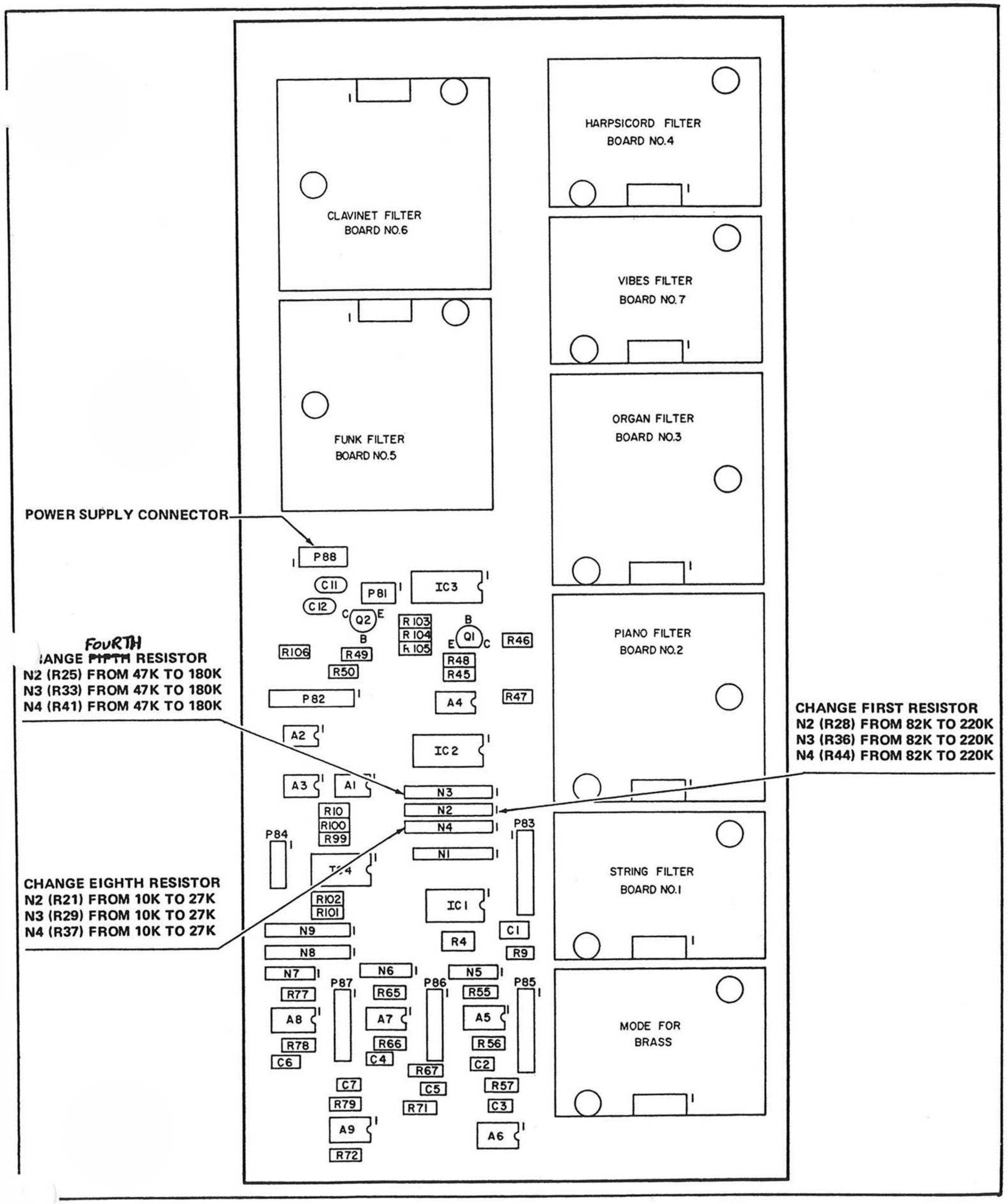

C5
C4
R2
R1
C2
R8
R7
C1
R9
R10
R3
A2
1
A1
1
R14
R13
R5
C7
C6
C3
R11
R4
R12
R6
S1
1
CHANGE R14 FROM 22K TO 110K
CHANGE R11 FROM 240K TO 47K

FIGURE 5 FUNK FILTER BOARD NO. 5 (POLYMOOG)

LOCATION: TOP CENTER BOARD 8 – Refer to Figure 6.
N2 – Change resistor No. 8 R21 from 10K to 27K.
N2 – Change resistor No. 1 R28 from 82K to 220K.
N2 – Change resistor No. 5 R25 from 47K to 180K.
N3 – Change resistor No. 8 R29 from 10K to 27K.
N3 – Change resistor No. 1 R36 from 82K to 220K.
N3 – Change resistor No. 5 R33 from 47K to 180K.
N4 – Change resistor No. 8 R37 from 10K to 27K.
N4 – Change resistor No. 1 R44 from 82K to 220K.
N4 – Change resistor No. 5 R41 from 47K to 180K.

LOCATION: TOP RIGHT BOARD 9 – Refer to Figure 7.
N5 - Change resistor No. 7 R146 from 10K to 27K.


HARPSICORD FILTER BOARD NO.4
CLAVINET FILTER BOARD NO.6
VIBES FILTER BOARD NO.7
FUNK FILTER BOARD NO.5
ORGAN FILTER BOARD NO.3
PIANO FILTER BOARD NO.2
STRING FILTER BOARD NO.1
MODE FOR BRASS
P88
P81
P82
P83
P84
P85
P86
P87
IC1
IC2
IC3
N1
N2
N3
N4
N5
N6
N7
N8
N9

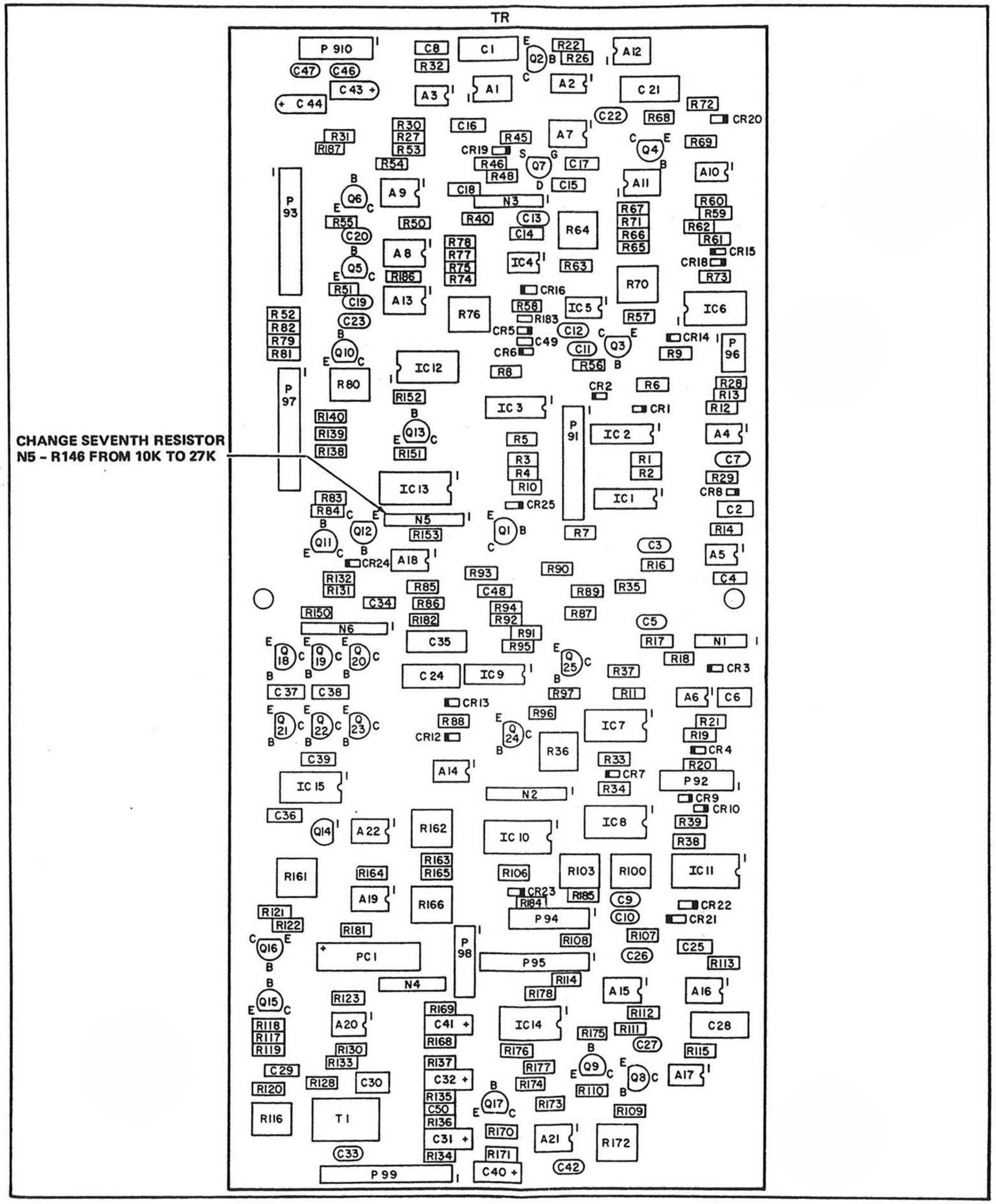
POWER SUPPLY CONNECTOR

ANGE ~~FIFTH~~ FOURTH RESISTOR
N2 (R25) FROM 47K TO 180K
N3 (R33) FROM 47K TO 180K
N4 (R41) FROM 47K TO 180K

CHANGE FIRST RESISTOR
N2 (R28) FROM 82K TO 220K
N3 (R36) FROM 82K TO 220K
N4 (R44) FROM 82K TO 220K

CHANGE EIGHTH RESISTOR
N2 (R21) FROM 10K TO 27K
N3 (R29) FROM 10K TO 27K
N4 (R37) FROM 10K TO 27K

FIGURE 6 FIXED AND VARIABLE RESONANT FILTERS PRINTED CIRCUIT TC BOARD 8 (POLYMOOG)

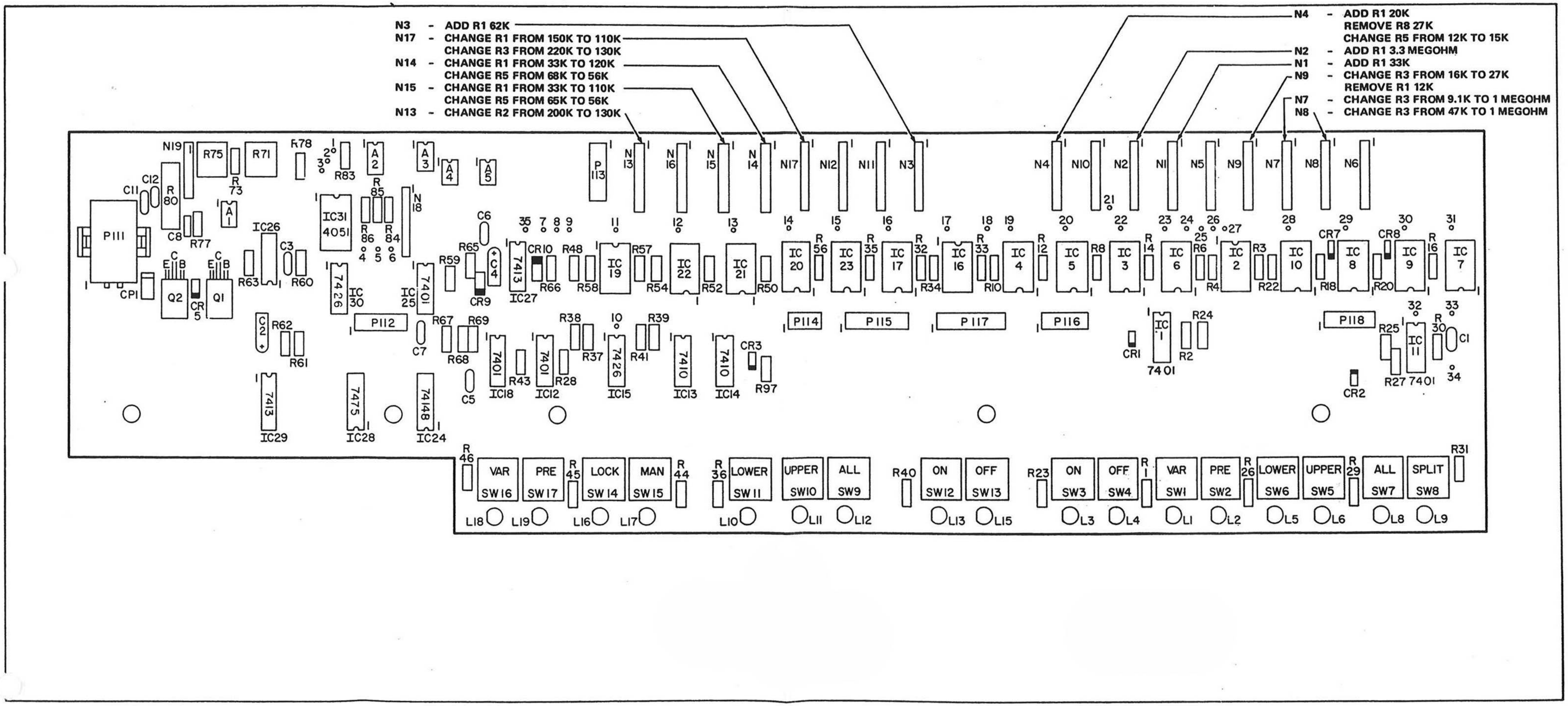

TR
P 910
P 93
P 96
P 97
P 91
P 92
P 94
P 95
P 98
P 99
PC1
T1
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC8
IC9
IC10
IC11
IC12
IC13
IC14
IC15
N1
N2
N3
N4
N5
N6

CHANGE SEVENTH RESISTOR
N5 - R146 FROM 10K TO 27K

FIGURE 7 VOLTAGE CONTROLLED FILTER AND KEYBOARD CIRCUIT PRINTED CIRCUIT TR BOARD 9 (POLYMOOG)

LOCATION: RIGHT HAND CONTROL BOARD 11 - Refer to Figure 8.

N1 - Add R1, 33K.
N2 - Add R1, 3.3 Megohm.
N3 - Add R1, 62K.
N4 - Add R1, 20K.
N4 - Remove R8, 27K.
N4 - Change R5 from 12K to 15K.
N7 - Change R3 from 9.1K to 1 Megohm.
N8 - Change R3 from 47K to 1 Megohm.
N9 - Change R3 from 16K to 27K.
N9 - Remove R1, 12K.
N13 - Change R2 from 200K to 130K.
N14 - Change R1 from 33K to 120K.
N14 - Change R5 from 68K to 56K.
N15 - Change R1 from 33K to 110K.
N15 - Change R5 from 68K to 56K.
N17 - Change R1 from 150K to 110K.
N17 - Change R3 from 220K to 130K.


N3 - ADD R1 62K
N17 - CHANGE R1 FROM 150K TO 110K
CHANGE R3 FROM 220K TO 130K
N14 - CHANGE R1 FROM 33K TO 120K
CHANGE R5 FROM 68K TO 56K
N15 - CHANGE R1 FROM 33K TO 110K
CHANGE R5 FROM 65K TO 56K
N13 - CHANGE R2 FROM 200K TO 130K

N4 - ADD R1 20K
REMOVE R8 27K
CHANGE R5 FROM 12K TO 15K
N2 - ADD R1 3.3 MEGOHM
N1 - ADD R1 33K
N9 - CHANGE R3 FROM 16K TO 27K
REMOVE R1 12K
N7 - CHANGE R3 FROM 9.1K TO 1 MEGOHM
N8 - CHANGE R3 FROM 47K TO 1 MEGOHM

N19
R75
R71
R78
R83
A2
A3
A4
A5
A1
C11
C12
R80
R73
C8
R77
P111
CP1
Q2
Q1
CR5
IC26
C3
R63
R60
IC31 4051
R85
R86
R84
N18
7426
IC30
IC25
7401
P112
C2
R62
R61
7413
IC29
7475
IC28
74148
IC24
C6
R65
R59
C4
CR9
7413
IC27
CR10
R66
R48
R58
IC19
R57
R54
IC22
R52
IC21
R50
P113
N13
N16
N15
N14
N17
N12
N11
N3
N4
N10
N2
N1
N5
N9
N7
N8
N6
IC20
R56
IC23
R35
IC17
R32
R34
IC16
R33
R10
IC4
R12
IC5
R8
IC3
R14
IC6
R6
R4
IC2
R3
R22
IC10
R18
CR7
IC8
CR8
R20
IC9
R16
IC7
P114
P115
P117
P116
P118
R67
R69
R68
C7
C5
7401
IC18
R43
7401
IC12
R28
R38
R37
7426
IC15
R39
R41
7410
IC13
7410
IC14
CR3
R97
IC1
7401
CR1
R24
R2
R25
IC11
7401
R27
R30
C1
CR2
R46
VAR SW16
PRE SW17
R45
LOCK SW14
MAN SW15
R44
R36
LOWER SW11
UPPER SW10
ALL SW9
R40
ON SW12
OFF SW13
R23
ON SW3
OFF SW4
R1
VAR SW1
PRE SW2
R26
LOWER SW6
UPPER SW5
R29
ALL SW7
SPLIT SW8
R31
L18
L19
L16
L17
L10
L11
L12
L13
L15
L3
L4
L1
L2
L5
L6
L8
L9

FIGURE 8 RIGHT HAND CONTROL AND MASTER PRESET PRINTED CIRCUIT CR BOARD 11 (POLYMOOG)

RELIABILITY AND PERFORMANCE IMPROVEMENT

LOCATION: POWER SUPPLY BOARD 13. Refer to Figure 9.

a. Thermal Coupling Improvement Between Power Supply And Rear Panel Extrusion.

Counter bore 1/2 inch (12.7mm) diameter x 3/32 inch (2.4mm) deep in three (3) places as indicated at heat sink mounting holes. Remove all burrs.

File printed circuit board overhang until flush with the heat sink. On occasion the mounting hardware screw heads may also need filing. In addition, the printed circuit board mounting holes (to the rear panel) may need to be enlarged to allow the power supply to be reseated in a lower position once the overhang has been filed off.

b. Pass Transistor Improvement.

Remove 2N5494 transistors.

Clear the solder from around the transistor mounting pads.

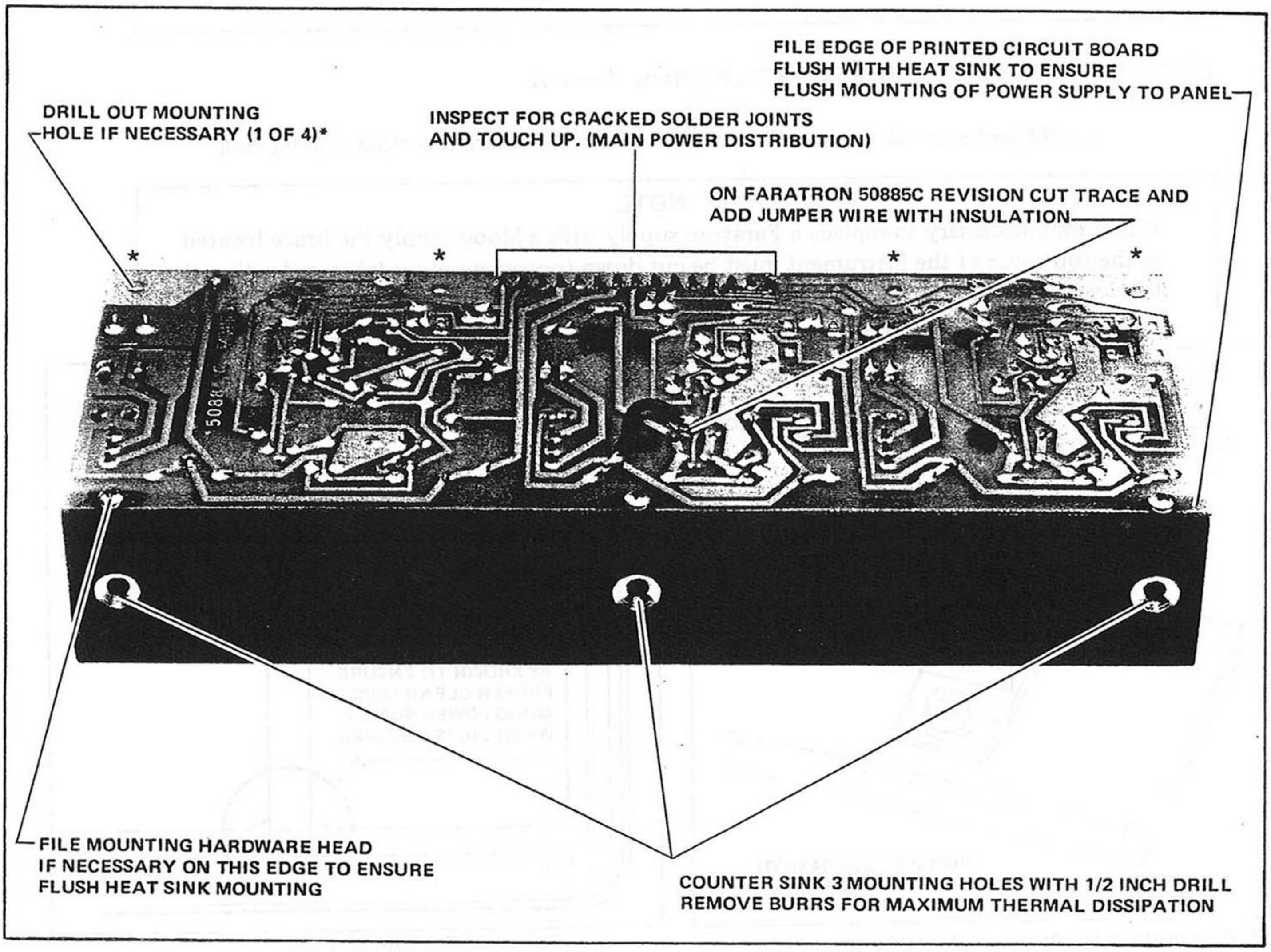

FILE EDGE OF PRINTED CIRCUIT BOARD FLUSH WITH HEAT SINK TO ENSURE FLUSH MOUNTING OF POWER SUPPLY TO PANEL
DRILL OUT MOUNTING HOLE IF NECESSARY (1 OF 4)*
INSPECT FOR CRACKED SOLDER JOINTS AND TOUCH UP. (MAIN POWER DISTRIBUTION)
ON FARATRON 50885C REVISION CUT TRACE AND ADD JUMPER WIRE WITH INSULATION
*
*
*
*
FILE MOUNTING HARDWARE HEAD IF NECESSARY ON THIS EDGE TO ENSURE FLUSH HEAT SINK MOUNTING
COUNTER SINK 3 MOUNTING HOLES WITH 1/2 INCH DRILL REMOVE BURRS FOR MAXIMUM THERMAL DISSIPATION

FIGURE 9 POWER SUPPLY PRINTED CIRCUIT BOARD 13 (POLYMOOG AND POLYMOOG KEYBOARD)

Stress relieve replacement transistors as shown in Figure 10. Use a pair of needlenose pliers. Do not make sharp bends in the leads as they will fracture.

Attach TIP41/RCA41 transistors to the heat sink and secure with mounting hardware. Ensure that the insulators are properly seated.

Solder the transistor legs in place.

c. Prevent +15 Volt Supply Over Voltage Condition.

This applies only to Faratron power supply subassembly 50885 C revision as identified with this part number etched on some of the printed circuit boards. Sense diode CR20 not connected according to schematic layout due to improper printed circuit board etch.

Correction - Cut trace and add jumper wire with sleeving.

NOTE

Intermittent or unstable operation of any of the three main power supply voltages may be due to cracked solder joints at the main power supply printed circuit connector P131. Inspect the soldering at all 15 pins and touch up as needed.

LOCATION: POWER SUPPLY BOARD 13. (Moog Version)

a. Add protective sleeving to filter capacitor leads that are too close to heat sink.

NOTE

If it is ever necessary to replace a Faratron supply with a Moog supply the brace located in the top cover of the instrument must be cut down (power supply side) in order that the lid clears the supply subassembly. See Sketch.

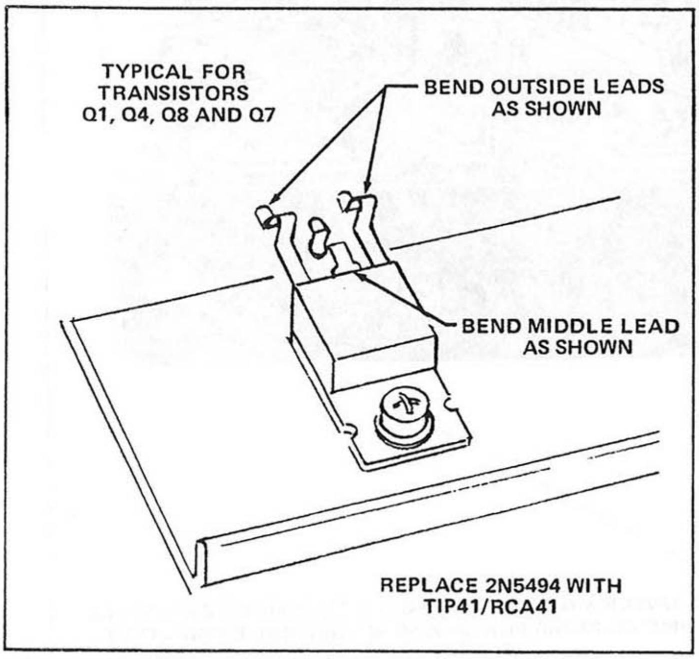
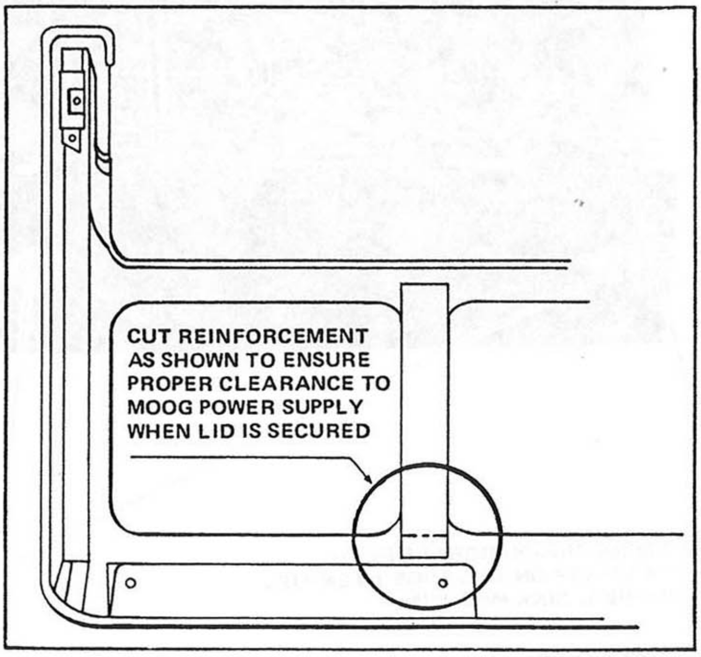

TYPICAL FOR TRANSISTORS Q1, Q4, Q8 AND Q7
BEND OUTSIDE LEADS AS SHOWN
BEND MIDDLE LEAD AS SHOWN
REPLACE 2N5494 WITH TIP41/RCA41

FIGURE 10 POWER SUPPLY TRANSISTOR MODIFICATION (POLYMOOG AND POLYMOOG KEYBOARD)


CUT REINFORCEMENT AS SHOWN TO ENSURE PROPER CLEARANCE TO MOOG POWER SUPPLY WHEN LID IS SECURED

INSIDE VIEW TOP COVER

LOCATION: TOP LEFT BOARD 7. Refer to Figures 11 and 12.

REFERENCE OSCILLATOR

a. Prevent Jitter.

Change R57 and R83 from 10K ± 1% to 100K ± 5%.
Change C11 and C19 from 0.1uf polyester to 0.001uf polyester.

b. Prevent Oscillator Drift Due To Leaky Ribbon Controller.

Change R96 from selected value to 75K.
Add 10K resistor between CR1 anode and ground as shown (Figure 12).

c. Pitch Stability Due To Delicate Physical Construction Of Polycarbonate Capacitors.

Remove C13, C14, C21, C22 (0.001uf) polyester (white) or polycarbonate (green) capacitors.

Install new C13 and C21 (510pf) polystyrene capacitors as indicated.

d. Temperature Stabilization

Change R53, R55, R79, and R81 to 200K ± 1% resistors.
Cut two (2) traces on rear side of printed circuit board as shown in Figure 12.
Add a 953 ohm ± 1% resistor in two (2) places as shown in Figure 12.
Add a jumper wire in two (2) places as shown in Figure 12.

e. Reference Oscillator stability

Change R48 and R72 from 1K ± 1% to 10K ± 1%.
Change R97 from 40.2K ± 1% to 18.7K ± 1%.
Add a 0.01 disc capacitor (C40 and C41) across R49 and R75.

NOTE

Oscillators must be retuned after performing any of the above modifications. Allow settling time for polystyrene capacitors. (If possible, overnight burn-in.)

f. Phase Locked Loop Chirping. Figure 12.

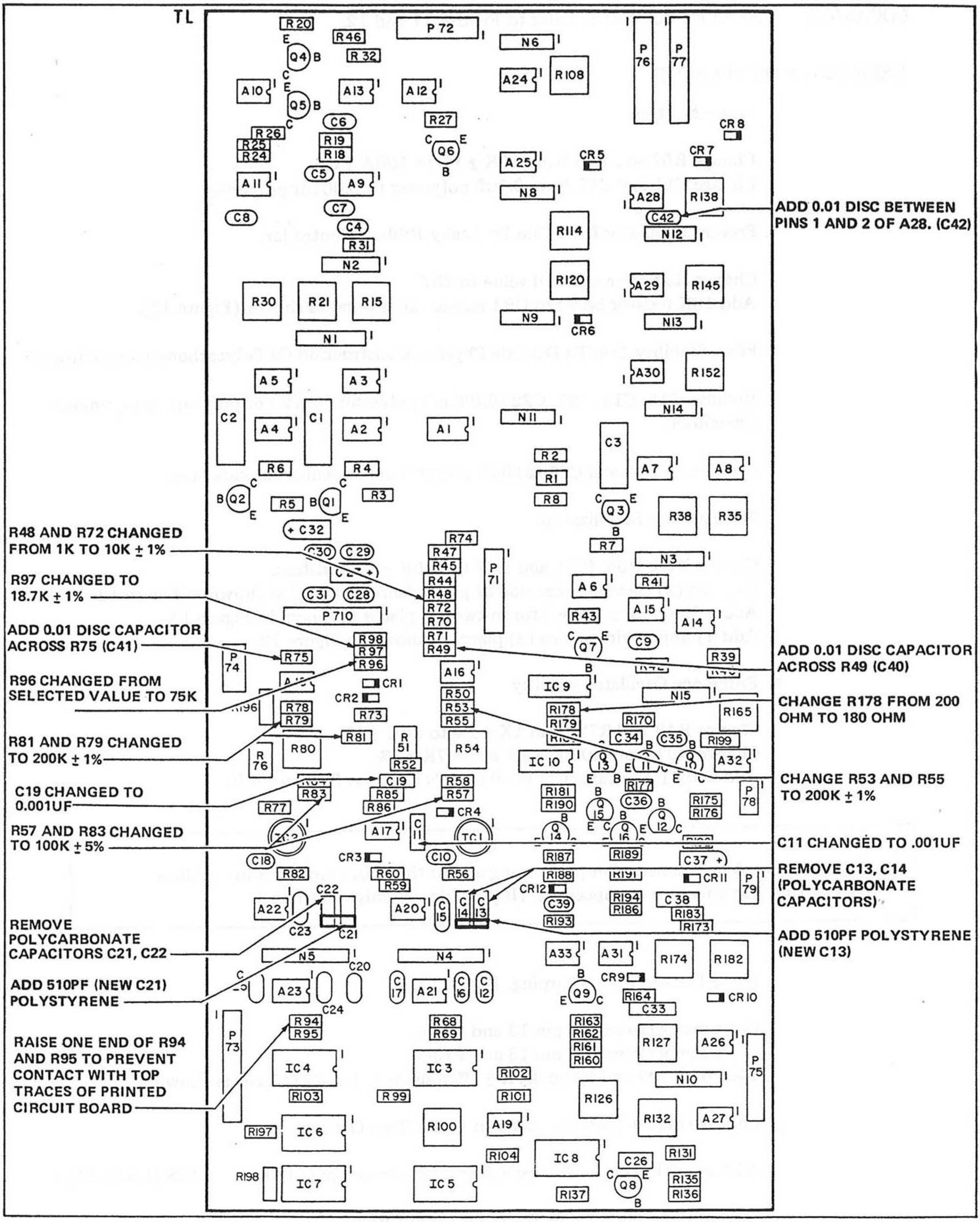
Cut trace between IC6 pin 13 and P73-6.
Cut trace between IC7 pin 13 and P73-9.
Tack on R197 and R198 4.7K ± 5% resistor in two (2) places as shown.

g. Improve Signal-To-Noise Ratio In Upper Two Octaves.

Add an 0.01 ceramic disc capacitor C42 between pins 1 and 2 of A28 (LM358 IC).

h. Prevent Shorting To Top Traces Of Circuit Board.

Raise one end of R94 and R95.


TL
R20
P 72
R46
N6
Q4
R32
P 76
P 77
A24
R108
A10
A13
A12
Q5
CR8
C6
R27
R26
R25
R24
R19
R18
Q6
CR5
CR7
A25
A11
C5
A9
N8
A28
R138
C7
C42
C8
C4
R114
N12
R31
N2
R120
A29
R145
R30
R21
R15
N9
CR6
N13
N1
A30
R152
A5
A3
N14
C2
A4
C1
A2
A1
N11
C3
R2
R6
R4
A7
A8
R1
Q2
R5
Q1
R3
R8
Q3
R38
R35
C32
R74
R7
C30
C29
R47
P 71
N3
C27
R45
R44
A6
R41
C31
C28
R48
A15
P710
R72
R43
A14
R70
R98
R71
Q7
C9
R97
R49
R39
R75
R96
P 74
A16
R42
CR1
IC 9
CR2
R50
N15
R196
R78
R53
R178
R165
R73
R55
R179
R170
R79
R81
R 51
R54
C34
C35
R199
R80
R 76
IC 10
Q 13
Q 11
Q 10
A32
R52
R177
R64
C19
R58
P 78
R83
R85
R181
C36
R175
R57
R190
Q 15
Q 12
R176
R77
R86
CR4
IC2
A17
C 11
IC1
Q 14
Q 16
C18
CR3
C10
R187
R189
C37
R82
R60
R56
R188
R191
CR11
P 79
R59
CR12
C22
C 14
C 13
R194
C 38
A22
A20
C 15
R186
R183
C39
C23
C21
R193
R173
N5
N4
A33
A31
R174
R182
C25
C20
CR9
A23
C 17
A21
C 16
C 12
Q9
R164
CR10
C24
C33
R94
R68
R163
R95
R69
R162
R127
A26
P 73
R161
R160
IC 4
IC 3
P 75
R102
N10
R103
R99
R101
R126
R132
A27
R197
IC 6
R100
A19
R104
IC 8
R131
C26
R198
IC 7
IC 5
R135
R137
Q8
R136

ADD 0.01 DISC BETWEEN PINS 1 AND 2 OF A28. (C42)

R48 AND R72 CHANGED FROM 1K TO 10K ± 1%

R97 CHANGED TO 18.7K ± 1%

ADD 0.01 DISC CAPACITOR ACROSS R75 (C41)

ADD 0.01 DISC CAPACITOR ACROSS R49 (C40)

R96 CHANGED FROM SELECTED VALUE TO 75K

CHANGE R178 FROM 200 OHM TO 180 OHM

R81 AND R79 CHANGED TO 200K ± 1%

CHANGE R53 AND R55 TO 200K ± 1%

C19 CHANGED TO 0.001UF

R57 AND R83 CHANGED TO 100K ± 5%

C11 CHANGED TO .001UF

REMOVE C13, C14 (POLYCARBONATE CAPACITORS)

REMOVE POLYCARBONATE CAPACITORS C21, C22

ADD 510PF POLYSTYRENE (NEW C13)

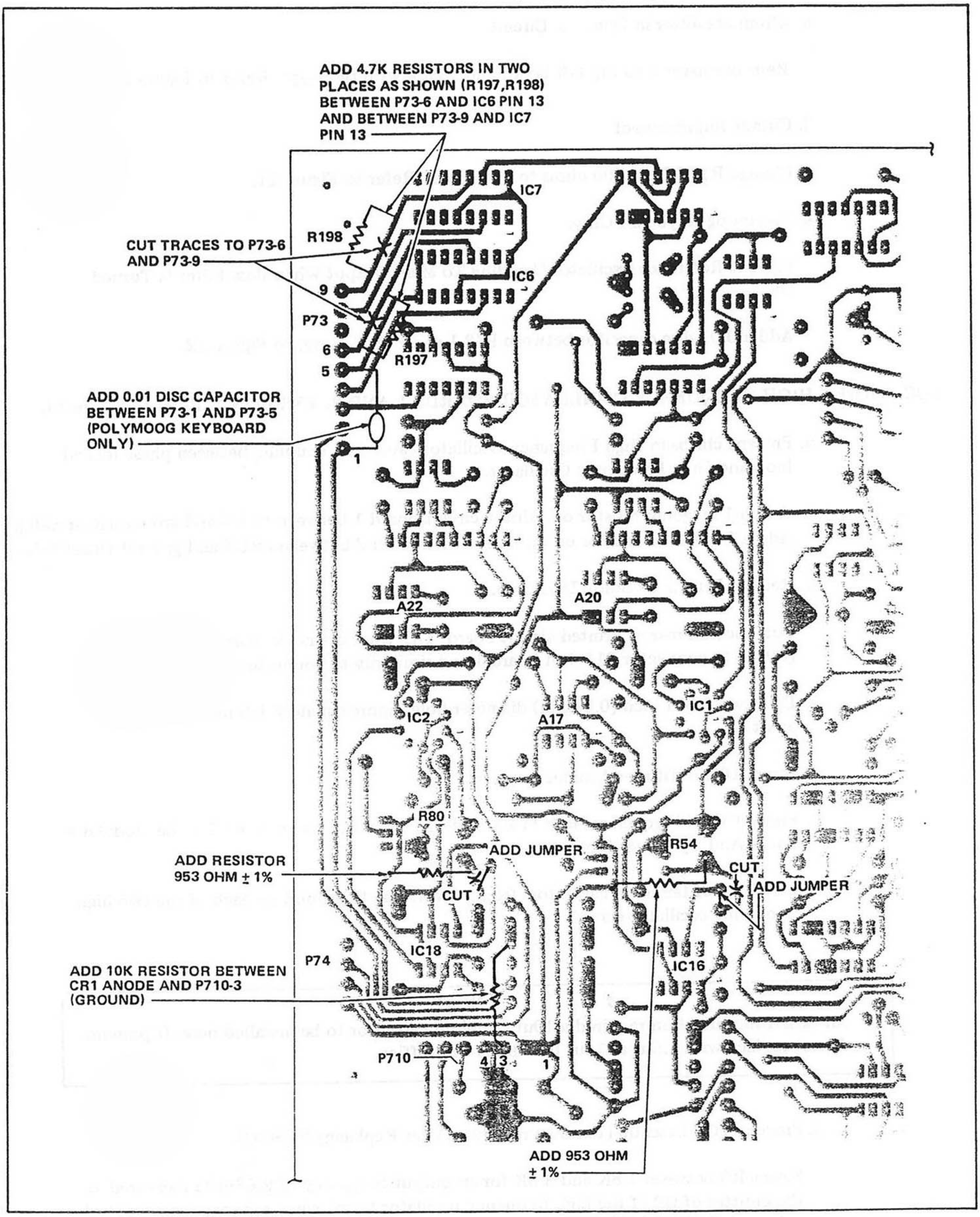
ADD 510PF (NEW C21) POLYSTYRENE

RAISE ONE END OF R94 AND R95 TO PREVENT CONTACT WITH TOP TRACES OF PRINTED CIRCUIT BOARD

FIGURE 11 REFERENCE AND MODULATION WAVESHAPE AND KEYBOARD CONTROL PRINTED CIRCUIT TL BOARD 7 (POLYMOOG AND POLYMOOG KEYBOARD)

1	2	3	4	5	9
6	7	8	9	•	

1	2	3	4	5	6	7	14
8	9	10	11	12	13	14	


IC7
R198
9
IC6
P73
6
5
R197
1
A22
A20
IC2
A17
IC1
R80
R54
IC18
P74
IC16
P710
4
3
1

ADD 4.7K RESISTORS IN TWO PLACES AS SHOWN (R197,R198) BETWEEN P73-6 AND IC6 PIN 13 AND BETWEEN P73-9 AND IC7 PIN 13

CUT TRACES TO P73-6 AND P73-9

ADD 0.01 DISC CAPACITOR BETWEEN P73-1 AND P73-5 (POLYMOOG KEYBOARD ONLY)

ADD JUMPER

ADD RESISTOR 953 OHM ± 1%

CUT

CUT

ADD JUMPER

ADD 10K RESISTOR BETWEEN CR1 ANODE AND P710-3 (GROUND)

ADD 953 OHM ± 1%

FIGURE 12 TEMPERATURE STABILIZATION CHANGES TL BOARD 7 (POLYMOOG AND POLYMOOG KEYBOARD)

LOCATION: TOP LEFT BOARD 7. (Continued)

i. Eliminate Jitter in Dynamic Circuit.

Re-route harness to top left board and secure with tie wraps. Refer to Figure 13.

j. Circuit Improvement.

Change R178 from 200 ohms to 180 ohms. Refer to Figure 11.

k. Polymoog Keyboard Only.

Prevent Reference Oscillator Coupling To Main Output When Bass Filter Is Turned On.

Add a 0.01 disc capacitor between P73-1 and P73-5. Refer to Figure 12.

LOCATION: HIGH FREQUENCY OSCILLATOR BOARDS 1 AND 2, VERSION 1. Refer to Figure 14.

a. Prevent chirps in High Frequency Oscillator caused by coupling between phase locked loop and High Frequency Oscillator.

Add a 1 megohm resistor on printed circuit board 1 between P11-5 and ground.(Rear Side).
Add a 1 megohm resistor on printed circuit board 2 between P21-5 and ground. (Rear Side).

b. Reduce Effects Of Static Discharge.

Cut trace on rear of printed circuit board. This trace connects from pin 4 of IC3 (4011) to connector P11-4 of board 1 and similarily to connector P21-4 of board 2.

Drill two 0.031 inch (0.69mm) diameter holes approximately 1/2 inch (12.7mm) apart.

Insert 10K resistor and solder in place.

c. Prevent High Frequency Hash From Appearing On The Clock Lines To The Modulator Cards And Dynamics Circuit.

Install 1.5uf tantalum capacitors from +5 volt line to ground on each of the two high frequency oscillator cards.

NOTE

An earlier modification required a 10uf tantalum capacitor to be installed here. If present, do not replace with 1.5uf as 10uf tantalums will suffice.

d. Prevent TOS Latchup (Follow Procedure After Replacing TOS IC).

Select R3 between 1.8K and 3.3K for an output frequency of 2.66mHz measured at the emitter of Q2 of the high frequency oscillator board when external pitch control volume input ≥ 3 VDC.

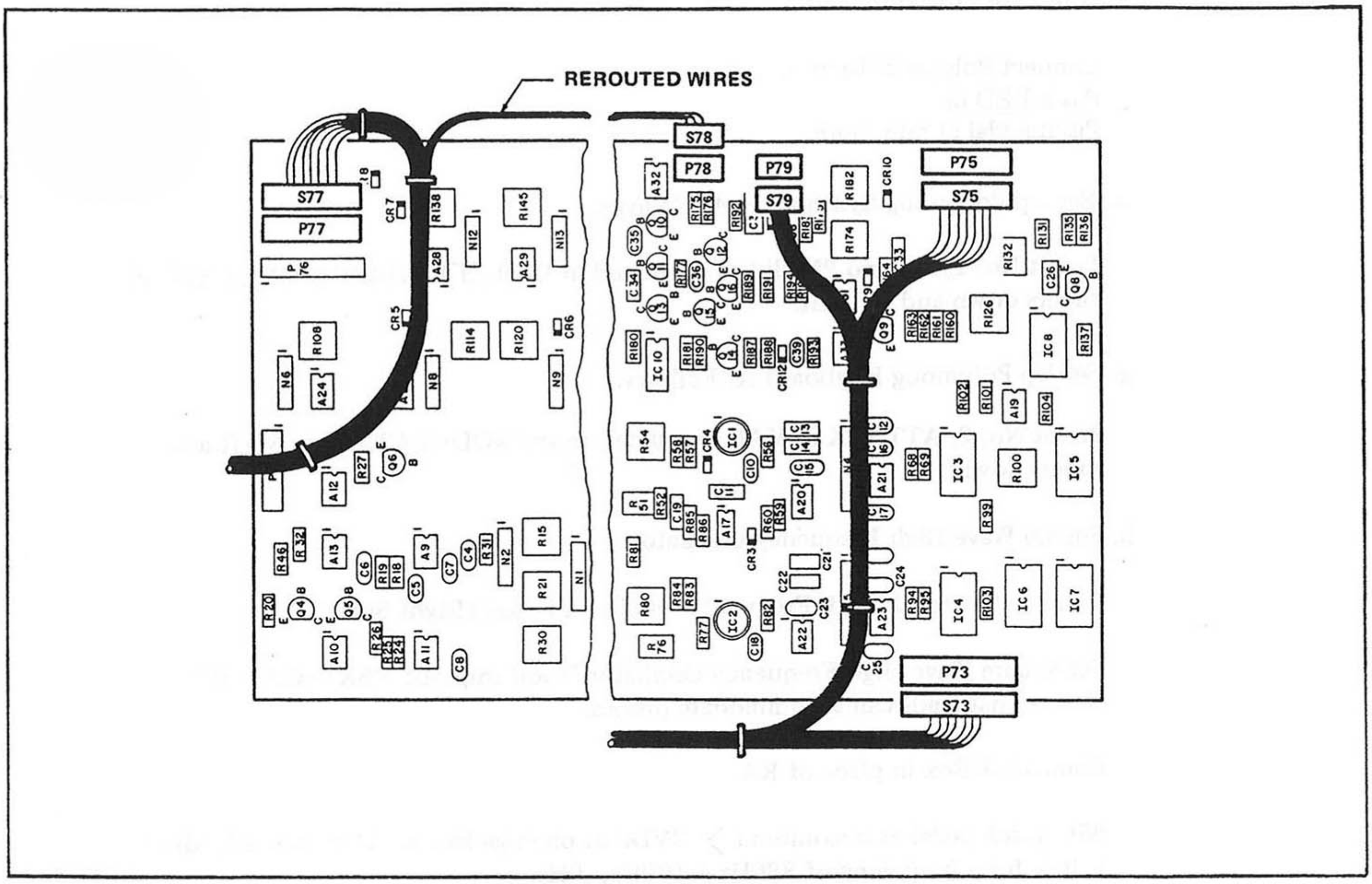

REROUTED WIRES
S78
P78
P79
S79
P75
S75
S77
P77
P73
S73

FIGURE 13 TL BOARD HARNESS REROUTING (POLYMOOG AND POLYMOOG KEYBOARD)

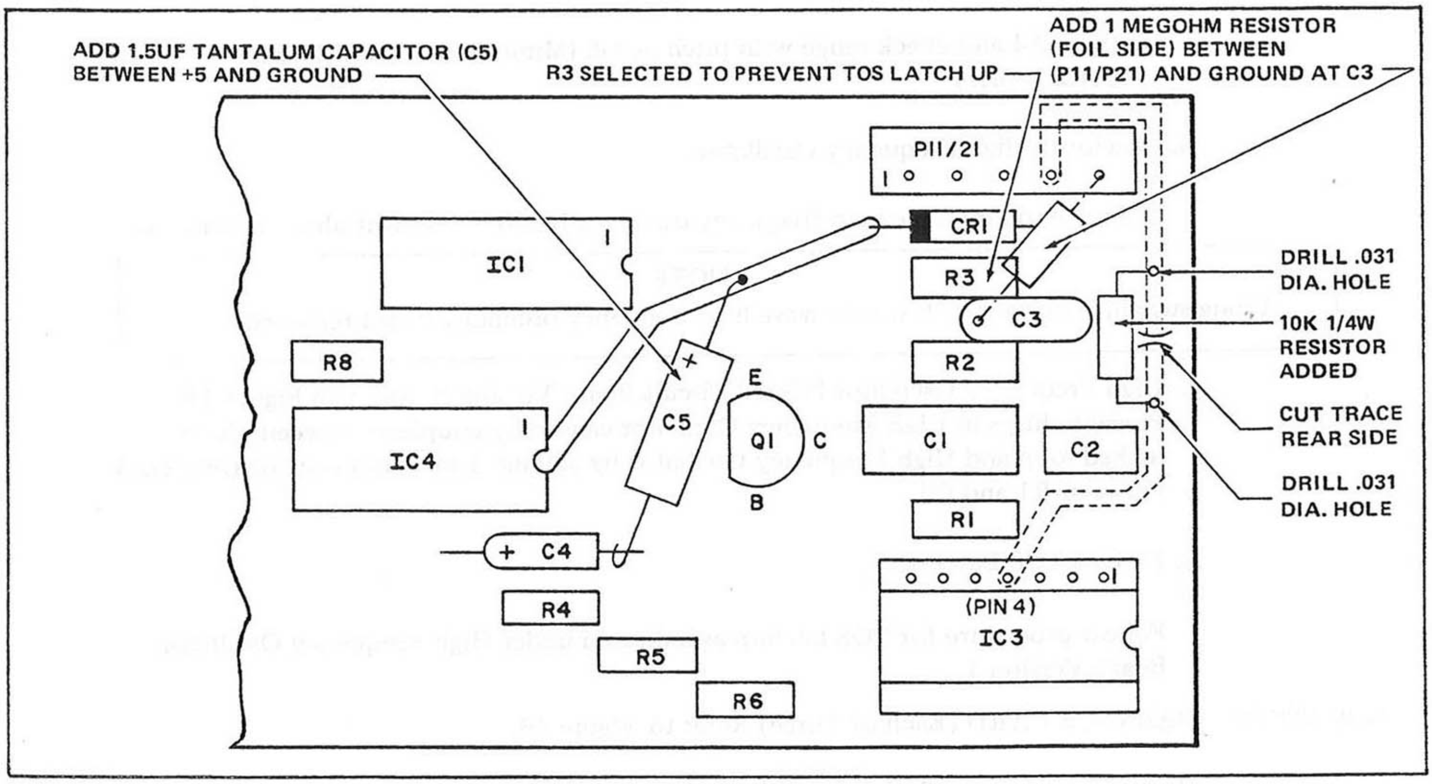

ADD 1.5UF TANTALUM CAPACITOR (C5) BETWEEN +5 AND GROUND
R3 SELECTED TO PREVENT TOS LATCH UP
ADD 1 MEGOHM RESISTOR (FOIL SIDE) BETWEEN (P11/P21) AND GROUND AT C3
DRILL .031 DIA. HOLE
10K 1/4W RESISTOR ADDED
CUT TRACE REAR SIDE
DRILL .031 DIA. HOLE
P11/21
CR1
IC1
R3
C3
R8
R2
C5
Q1
C1
C2
IC4
R1
C4
(PIN 4)
IC3
R4
R5
R6

FIGURE 14 HIGH FREQUENCY OSCILLATOR PRINTED CIRCUIT HFO BOARD (VERSION 1) (POLYMOOG AND POLYMOOG KEYBOARD)

e. Alternate Procedure Setup.

Connect Polypedal to unit.
Pitch LED on.
Pitch pedal at minimum.

f. Set Up Polymoog Synthesizer As Follows:

Preset No. 1, FM and PM sliders down and in VAR; ⎍ SHAPE/MODULATION sliders down and in VAR.

g. Set Up Polymoog Keyboard As Follows:

Preset No. 2, ATTACK in VAR and slider down; MODULATION in VAR and sliders down.

h. Square Wave High Frequency Oscillator.

Remove Sawtooth High Frequency Oscillator Board (Right Side).

On Square Wave High Frequency Oscillator Board snip out 1.5K resistor R3. Ensure that leads can accommodate probes.

Connect R Box in place of R3.

With pitch pedal at maximum (> 3VDC at pitch jack) and A4 depressed, adjust R Box for a frequency of 880Hz + 100Hz, -0Hz.

Insert selected value resistor and solder in place.

Depress A4 and check range with pitch pedal. (Minimum 440Hz) (Maximum 880Hz, +100Hz, - 0Hz).

i. Sawtooth High Frequency Oscillator.

Remove square wave high frequency oscillator board and repeat above procedure.

NOTE

A long sustain is normal with square wave high frequency oscillator board removed.

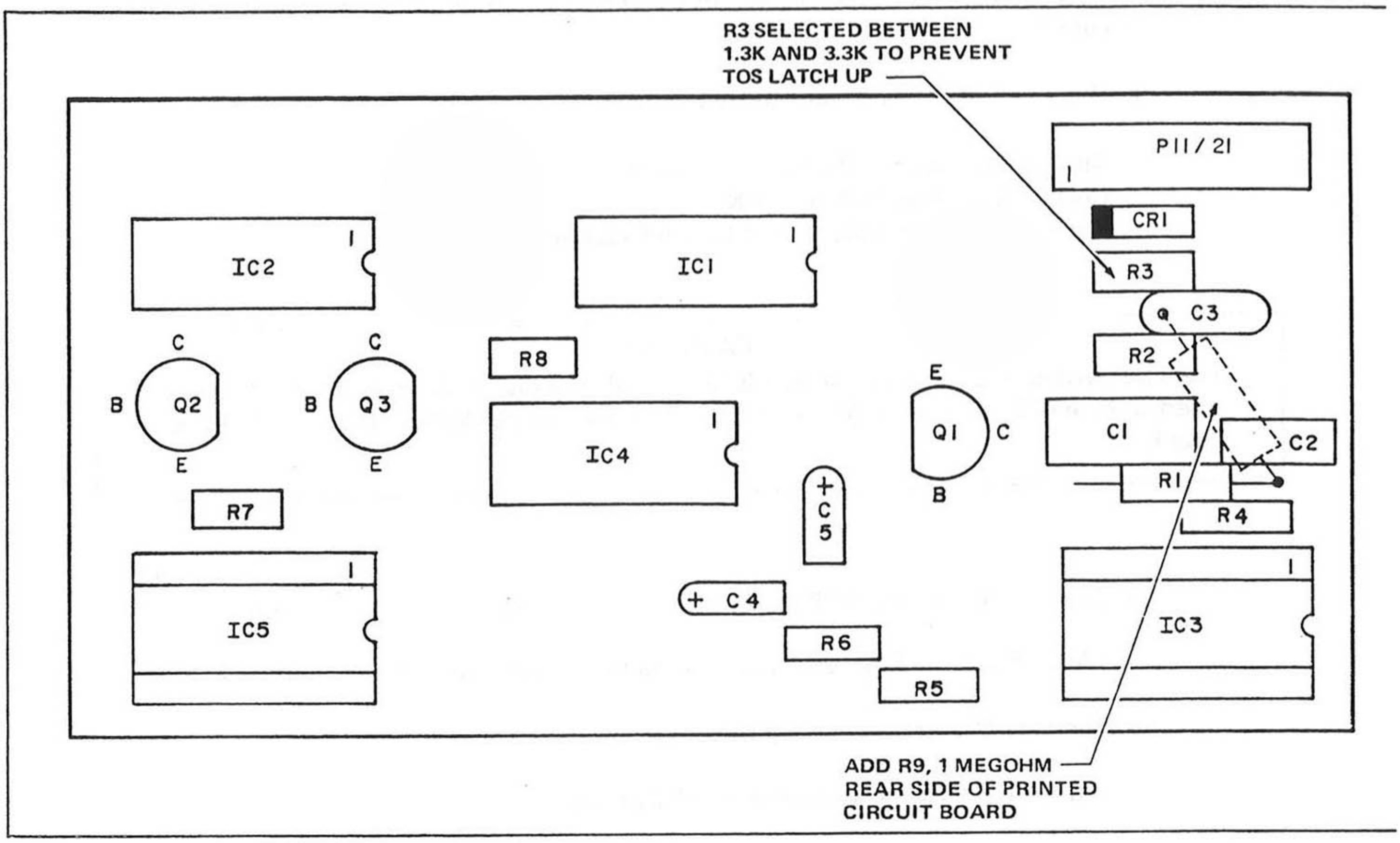
j. High Frequency Oscillator Printed Circuit Board Version 2. Refer to Figure 15. Prevent chirps in High Frequency Oscillator caused by coupling between phase locked loop and High Frequency Oscillator by adding 1 megohm resistor (rear side) between R1 and C3.

k. Prevent TOS Latchup.

Follow procedure for TOS latchup as indicated under High Frequency Oscillator Board Version 1.

LOCATION: BALANCE CARD (Each of Three) Refer to Figure 16.

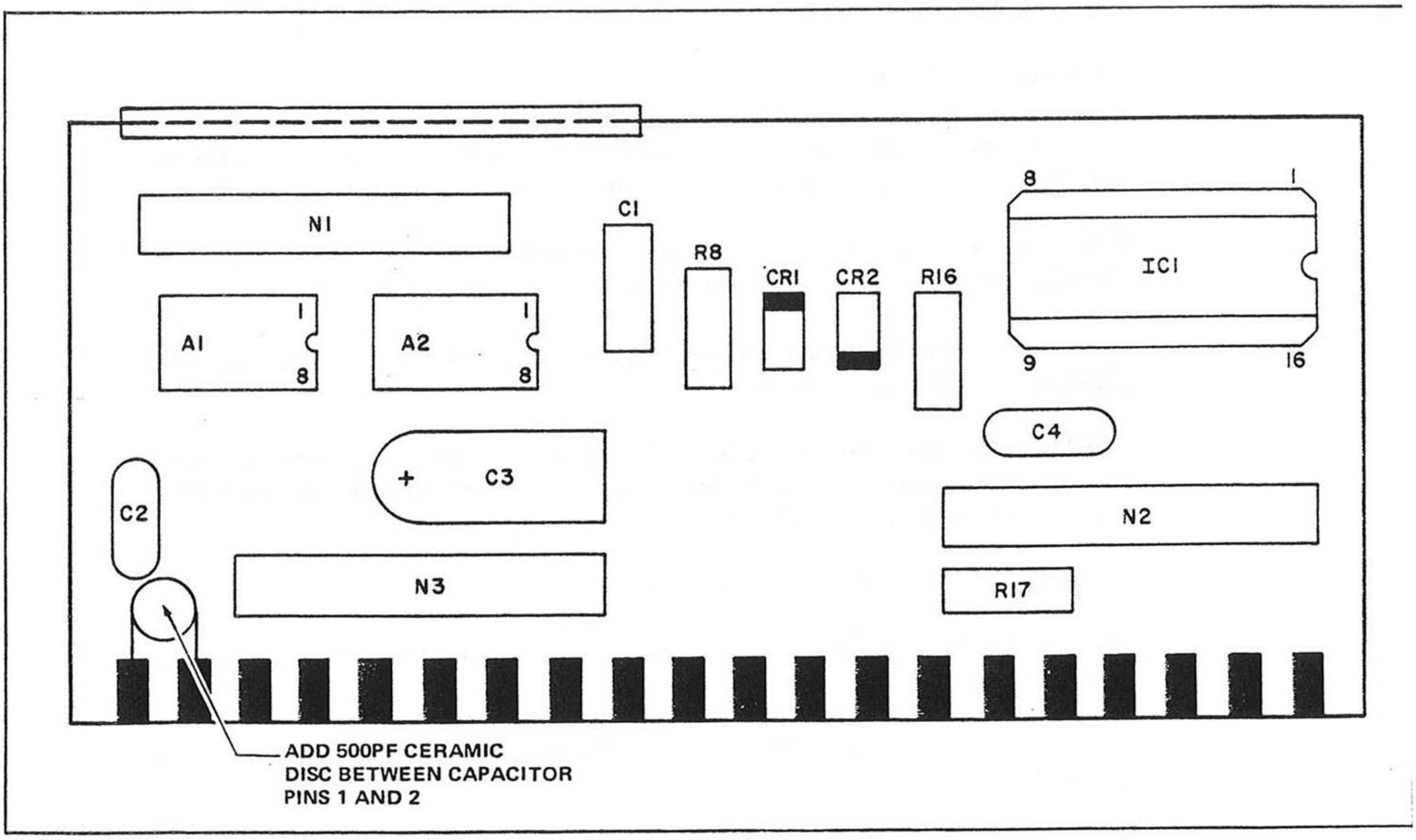
Reduce parasitic oscillation by adding a 500pf ceramic disc capacitor between pins 1 and 2 (V+ and V– respectively) on each of the three (3) balance cards.


P11/21
1
CR1
R3
C3
R2
C1
C2
R1
R4
IC2
IC1
1
1
C
B
Q2
E
C
B
Q3
E
R8
IC4
1
E
Q1
C
B
+
C
5
R7
IC5
1
+ C4
R6
R5
IC3
1

R3 SELECTED BETWEEN
1.3K AND 3.3K TO PREVENT
TOS LATCH UP

ADD R9, 1 MEGOHM
REAR SIDE OF PRINTED
CIRCUIT BOARD

FIGURE 15 HIGH FREQUENCY OSCILLATOR PRINTED CIRCUIT HFO BOARD (VERSION 2) (POLYMOOG AND POLYMOOG KEYBOARD)


N1
C1
R8
CR1
CR2
R16
8
1
IC1
9
16
A1
1
8
A2
1
8
C4
+
C3
C2
N2
N3
R17

ADD 500PF CERAMIC
DISC BETWEEN CAPACITOR
PINS 1 AND 2

FIGURE 16 BALANCE CARD (POLYMOOG AND POLYMOOG KEYBOARD)

LOCATION: TOP RIGHT PRINTED CIRCUIT BOARD 9 (VCF and Keyboard Circuit) Refer to Figure 17.

a. Contour Generator Temperature Stability.

Change R68 from 470K to 4.7 megohm.
Change R71 from 15K to 160K.
Change R70 from 10K cermet to 200K carbon trim.

CAUTION

Exercise extreme care when removing R70 trimpot. If a plated through hole is damaged, insert a piece of buss wire in the damaged hole and solder in place on both sides of the board.

b. Eliminate Click Caused With Attack And Decay Sliders Set At Minimum.

Add R183, 100 ohm resistor in series between pin 8 and +15V supply at IC5.

c. Eliminate Oscillation In Brightness Circuit.

Add R187, 2.7K between pins 1 and 4 of A3.

d. Reduction Of Drift In Keyboard Sample And Hold Circuit.

Change C25 from 0.1 to 0.47 polyester.

e. VCF Noise Reduction.

Remove small shield board located beneath the VCF board and replace with large shield. Ensure that foil side faces the modulator cards to prevent short circuits.

Install ground strap and locate one end between new shield and metal standoff. Install other end to front panel subassembly as shown in Figure 24.

Change printed circuit board mounting screw securing shield, etc., from 3/8 inch (9.5mm) to 1/2 inch (12.7mm).

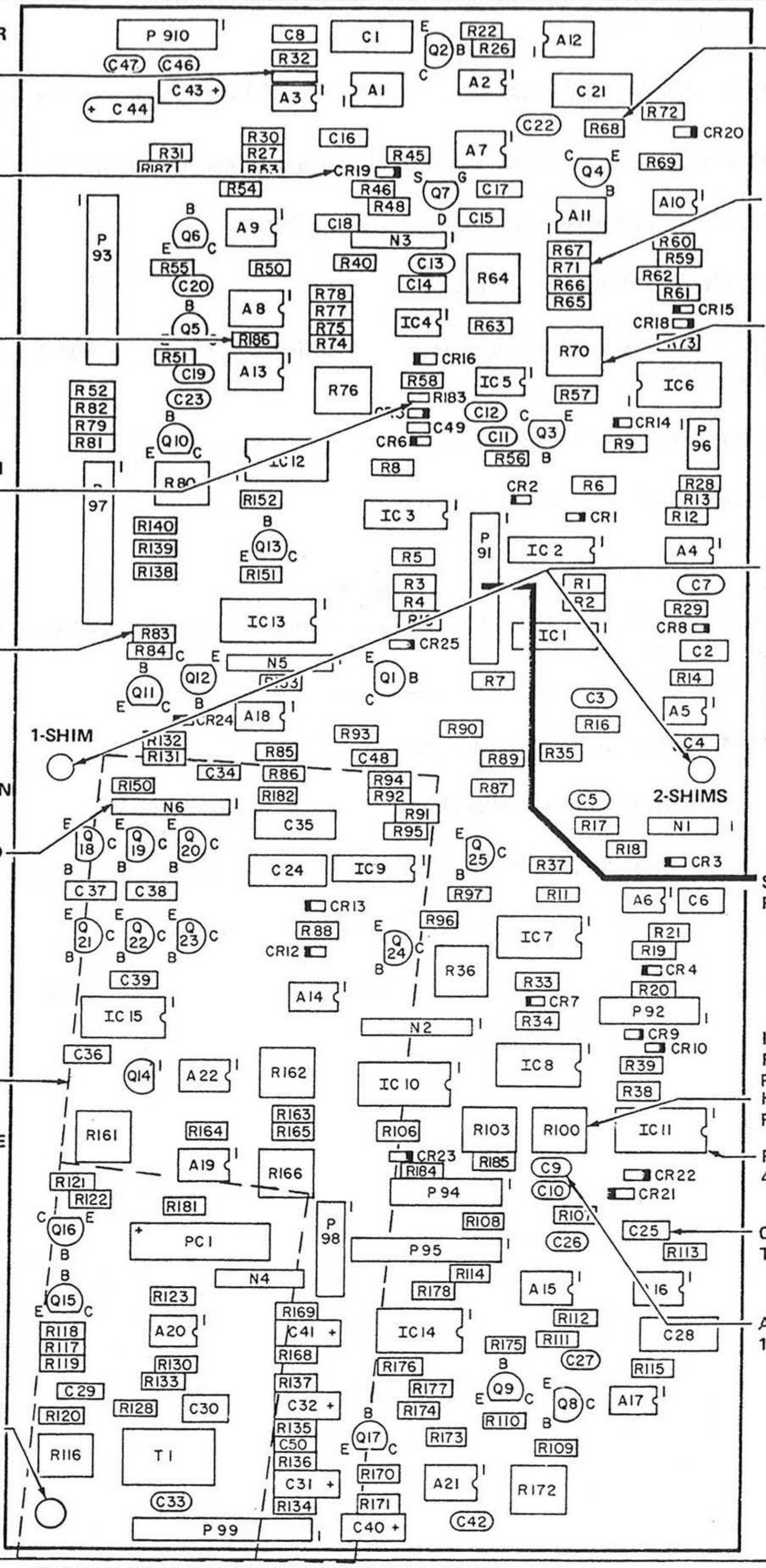
Level printed circuit board by adding 6-32 nuts as shims between top of mother board and the two center standoffs as indicated. Secure hardware in place. This prevents stress buildup at N6 which causes VCF shutdown.

f. Prevent Clicks In Output From S-TRIG.

Reroute S-Trig (orange) wire directly between P91-4 and P1-2 (S-TRIG output connector on rear panel) as follows:

Trace orange wire between P91-4 and P02-2 and cut at P02-2 end. Only solid orange wire in P02 connector.

Pull orange wire out of harness and strip end.


P 910
C8
C1
R22
R26
Q2
A12
R32
C47
C46
C43
A3
A1
A2
C 21
C 44
C22
R68
R72
CR20
R31
R187
R30
R27
R53
C16
R45
A7
Q4
R69
CR19
R54
R46
Q7
C17
R48
A10
A11
C15
P 93
Q6
A9
C18
N3
R60
R59
R55
R50
R40
C13
R67
R71
R62
C20
C14
R64
R66
R61
R65
CR15
A8
R78
R77
R75
R74
IC4
R63
CR18
Q5
R186
R70
R73
R51
A13
CR16
C19
R76
R58
IC 5
IC6
R57
R52
R82
R79
R81
C23
R183
C12
Q3
CR14
P 96
C49
C11
Q10
CR6
R9
IC 12
R56
R8
R80
CR2
R6
R28
97
R152
R13
IC 3
CR1
R12
R140
R139
R138
Q13
R151
P 91
IC 2
A4
R5
R3
R1
C7
R4
R2
R29
IC 13
R83
CR8
IC1
R84
CR25
C2
Q12
N5
Q1
R7
R14
Q11
R133
C3
A18
CR24
R16
A5
R132
R131
R93
R90
R85
C48
R89
R35
C4
C34
R86
R94
R150
R182
R92
R87
C5
N6
R91
R95
R17
N1
Q18
Q19
Q20
C 35
Q25
R18
CR 3
C 24
IC9
R37
C 37
C 38
R97
R11
A6
C6
CR13
R96
Q21
Q22
Q23
R88
IC7
R21
CR12
Q24
R19
R36
CR4
C39
R33
R20
A14
CR7
IC 15
P92
N2
R34
CR9
CR10
C36
Q14
A 22
R162
IC 10
IC8
R39
R38
R163
R165
R161
R164
R106
R103
R100
IC 11
A19
R166
CR23
R185
R184
C9
CR22
R121
R122
P 94
C10
CR21
Q16
R181
P 98
R108
R107
C25
PC I
P 95
C26
R113
N4
R114
A 15
16
Q15
R123
R169
R178
A20
C41
IC14
R112
C28
R118
R117
R119
R168
R175
R111
C27
R130
R176
R115
C29
R133
R137
R177
Q9
Q8
A17
R128
C30
C32
R174
R120
R110
R135
Q17
R173
C50
R116
T1
R136
R109
R170
A21
R172
C31
C33
R134
R171
C42
P 99
C40

ADD R187, 2.7K RESISTOR BETWEEN PINS 1 AND 4 OF A3

CHANGE CR19 FROM 1N4148 TO 1N34A

ADD 22K (R186) IN SERIES WITH Q5 COLLECTOR

R183, 100 OHM ADDED IN SERIES BETWEEN PIN 8 AND V+ AT IC5

CHANGE R83 FROM 510 OHM TO 430 OHM

1-SHIM

BOARD WARPAGE FRACTURES N6 AND THEN R159 (7K) OPENS - VCF SHUTS DOWN. LEVEL PRINTED CIRCUIT BOARD

REMOVE SMALL SHIELD PRINTED CIRCUIT BOARD LOCATED UNDERNEATH VCF BOARD AND REPLACE WITH LARGE SHIELD. ENSURE THAT FOIL SIDE FACES MODULATOR CARDS.

INSTALL GROUND STRAP BETWEEN SHIELD AND METAL SPACER TO ENSURE SOLID GROUND. (REFER TO FIGURE 24 FOR DETAILED VIEW.)

CHANGE R68 FROM 470K TO 4.7 MEGOHM

CHANGE R71 FROM 15K TO 160K

CHANGE R70 FROM 10K CERMET TO 200K CARBONATE TRIM POT

REMOVE 2 PRINTED CIRCUIT BOARD STAND-OFFS. ADD INDICATED NUMBER OF 6 x 32 NUTS AS SHIMS BETWEEN TOP OF MOTHER BOARD AND BASE OF STANDOFF. INSTALL HARDWARE AND SECURE

2-SHIMS

SOLDER DIRECTLY TO P1-2 (S-TRIG OUT)

IF NOT ENOUGH RANGE REPLACE 500 OHM TRIM POT WITH 1K TRIM KEYBOARD LOW RANGE R100

REPLACE 4016 WITH 4066BE

CHANGE C25 FROM 0.1 TO 0.47 POLYESTER

ADD R184 AND R185 10K ACROSS C9 AND C10

FIGURE 17 VOLTAGE CONTROLLED FILTER AND KEYBOARD CIRCUIT PRINTED CIRCUIT TR BOARD 9 (POLYMOOG)

Unsolder orange wire attached to S-TRIG out connector P1-2 and cut as short as possible to harness.

Attach and solder orange wire from P91-4 to S-TRIG out connector P1-2.

g. Improve Linearity Of The External Keyboard Control Voltage Output.

Replace IC11 (4016) with an RCA CD 4066 BE.

h. Sample And Hold Q5 Failure.

If circuit is not working prior to this modification, change BOTH A8 (CA3080) and Q5 (2N3906).

Add a 22K resistor R186 in series with the collector of Q5.

Change CR19 1N4148 from 1N34A.

NOTE

The above change is in conjunction with the change in the right hand control board as specified in step i below.

i. Right Hand Control Board 11. Refer to Figure 22.

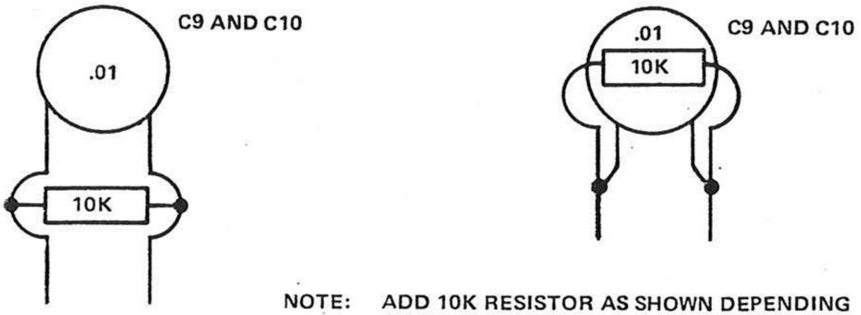
In modulation network (N2) change R5 from 200K to 100K.

j. Improve Triggering When Operating the VCF In The High/Low Split Mode.

Add 10K resistor across C9 and C10. Refer to Figure 18.

k. Decrease Scale Factor Of VCF to Conform With Latest Specifications.

Change R83 from 510 ohm to 430 ohm. VCF must be calibrated after this change.



NOTE: ADD 10K RESISTOR AS SHOWN DEPENDING ON CAPACITOR CONFIGURATION ON BOARD

FIGURE 18 TOP RIGHT BOARD 9 RESISTOR ADDITION (POLYMOOG)

LOCATION: TOP CENTER PRINTED CIRCUIT BOARD 8. Refer to Figure 19.

a. Prevent Clicks and Pops in Resonators.

Cut trace between S82 pin 5 and R10 on the component side of the printed circuit board.

Tack on and solder a 1.0uf polyester axial lead capacitor in series with P82-5.

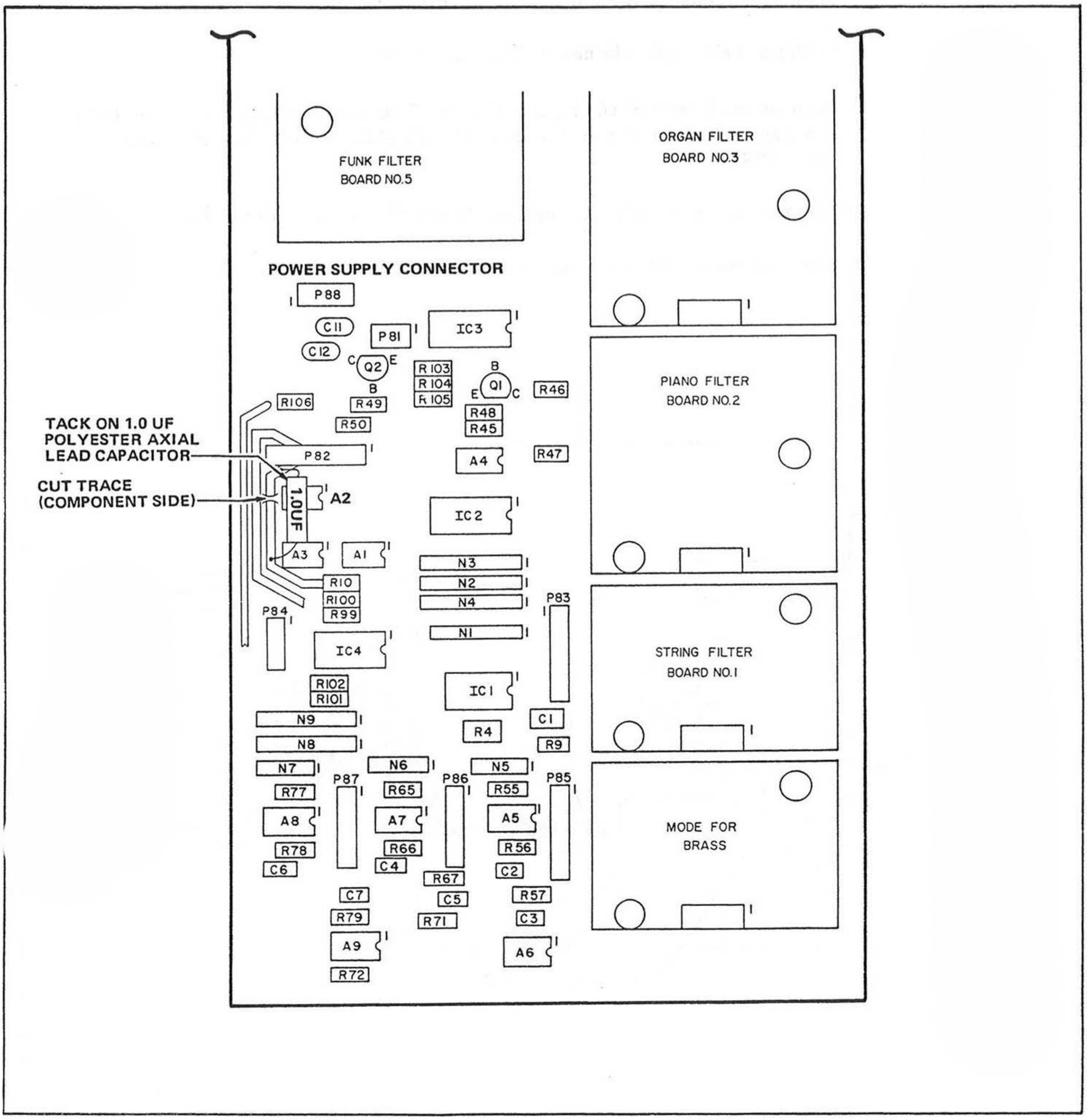

FUNK FILTER
BOARD NO.5
ORGAN FILTER
BOARD NO.3
POWER SUPPLY CONNECTOR
P88
C11
C12
P81
IC3
C
Q2
E
B
R103
R104
R105
B
E
Q1
C
R46
PIANO FILTER
BOARD NO.2
R106
R49
R48
R45
R50
TACK ON 1.0 UF
POLYESTER AXIAL
LEAD CAPACITOR
P82
A4
R47
CUT TRACE
(COMPONENT SIDE)
1.0UF
A2
IC2
A3
A1
N3
N2
N4
R10
R100
R99
P83
P84
N1
IC4
STRING FILTER
BOARD NO.1
R102
R101
IC1
N9
C1
N8
R4
R9
N7
N6
N5
P87
P86
P85
R77
R65
R55
A8
A7
A5
MODE FOR
BRASS
R78
R66
R56
C6
C4
C2
R67
R57
C7
C5
R79
R71
C3
A9
A6
R72

FIGURE 19 FIXED AND VARIABLE RESONANT FILTERS
PRINTED CIRCUIT TC BOARD 8 (POLYMOOG)

NOISE REDUCTION

LOCATION: TOP CENTER AND TOP RIGHT BOARDS. Refer to Figure 20.

To determine if this change is needed, connect a piece of buss wire between the 4.85 VDC rails of each board as designated. Listen to instrument with all MIX sliders down and if noise is significantly reduced, proceed as follows:

a. Drill .040 inch diameter hole on top center board as shown. Remove solder mask approximately 5/32-inch diameter around hole.

b. Solder in a single pin CIS header (P89) into hole.

c. Remove pin 2 from S910 (Figure 20 on VCF board). Strip back insulation from pin 2 and solder on an 8-inch piece of No. 22 AWG white/yellow wire with a single CIS socket.

d. Connect wire and socket to single pin CIS (S89) on top center board.

e. Use twist lock to anchor wire to existing harness on top center board.

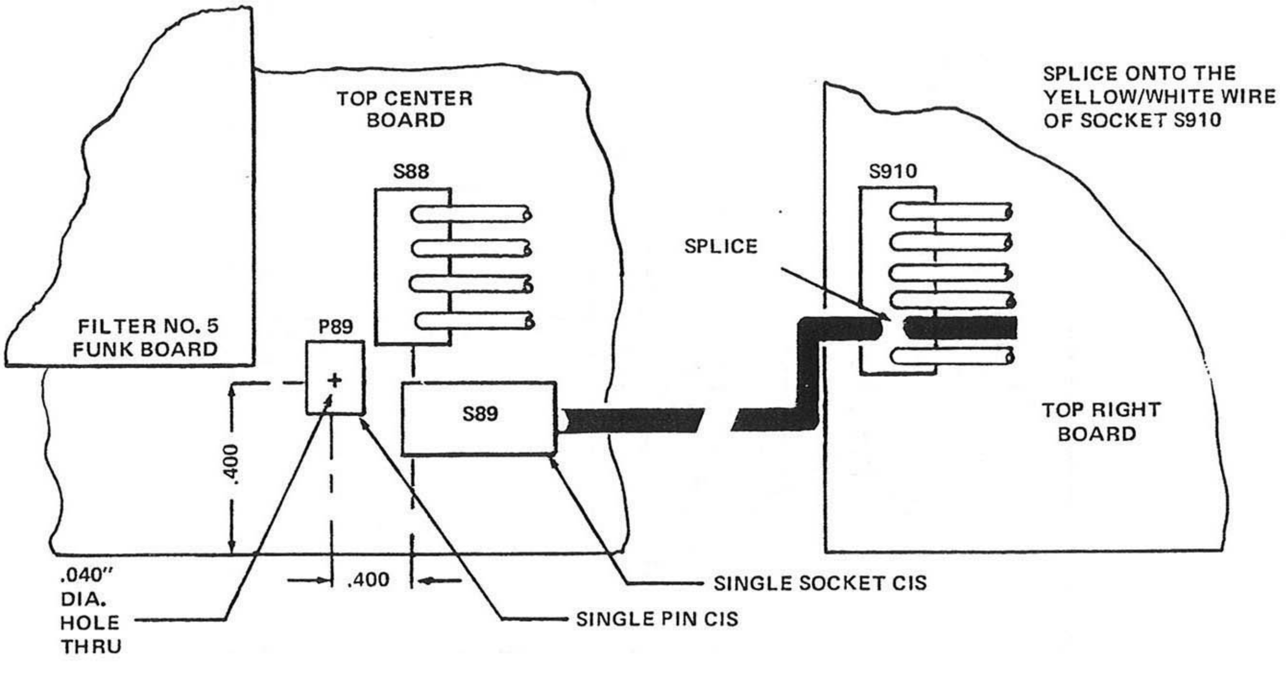

TOP CENTER BOARD
SPLICE ONTO THE YELLOW/WHITE WIRE OF SOCKET S910
S88
S910
SPLICE
FILTER NO. 5 FUNK BOARD
P89
S89
TOP RIGHT BOARD
.400
.040" DIA. HOLE THRU
.400
SINGLE SOCKET CIS
SINGLE PIN CIS

FIGURE 20 NEW CONNECTOR BETWEEN BOARDS (POLYMOOG)

LOCATION: LEFT HAND CONTROL BOARD 10. Refer to Figure 21.

a. Rank Tune Modification For Improved Oscillator Stability.

Change R17 from 510K or 430K to 422K ± 1%.
Change R18 from 1 megohm to 820K.
Change CR81 from 1N34A to 1N4148.

b. Pulse Width Modification For Improved Uniformity At 5% Setting.

Add a 300K resistor on bottom of board in three places:

Between pins 2 and 5 of IC15.
Between pins 11 and 14 of IC19.
Between pins 11 and 14 of IC17.

LOCATION: RIGHT HAND CONTROL BOARD 11. Refer to Figure 22.

a. Reduce Effects of Static Discharge. Refer to Figure 23.

Remove mounting hardware for the front panel assembly and fold back the assembly to expose the underside of the control boards.

Remove the four Phillips screws securing the front of the control board and discard all washers.

Obtain four (4) serrated ground lugs and cut to required length.

Reinstall original mounting screws and solder lugs to ground points.

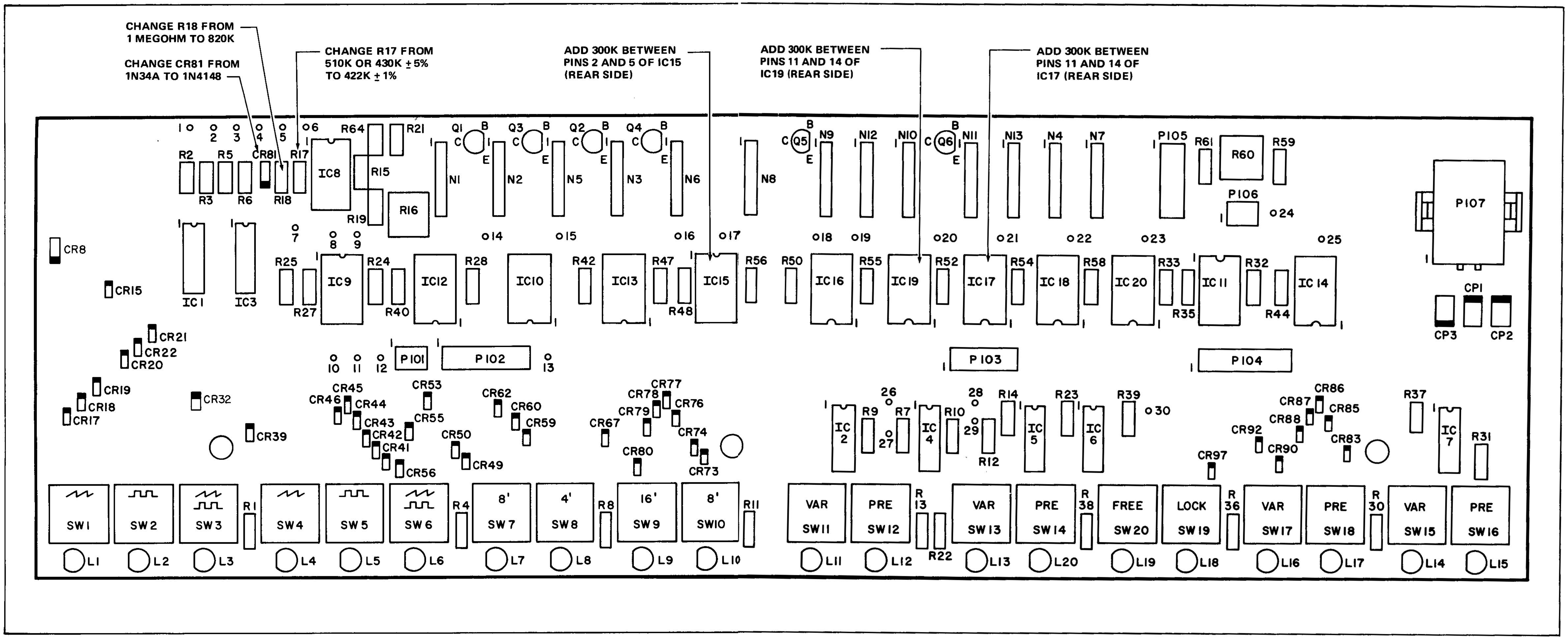

CHANGE R18 FROM 1 MEGOHM TO 820K
CHANGE CR81 FROM 1N34A TO 1N4148
CHANGE R17 FROM 510K OR 430K ± 5% TO 422K ± 1%
ADD 300K BETWEEN PINS 2 AND 5 OF IC15 (REAR SIDE)
ADD 300K BETWEEN PINS 11 AND 14 OF IC19 (REAR SIDE)
ADD 300K BETWEEN PINS 11 AND 14 OF IC17 (REAR SIDE)
R2 R3 R5 R6 CR81 R18 R17 IC8 R64 R15 R19 R16 R21
Q1 Q3 Q2 Q4 Q5 Q6 N1 N2 N5 N3 N6 N8 N9 N12 N10 N11 N13 N4 N7
P105 R61 R60 R59 P106 P107 CP1 CP2 CP3
IC1 IC3 IC9 IC12 IC10 IC13 IC15 IC16 IC19 IC17 IC18 IC20 IC11 IC14
R25 R27 R24 R40 R28 R42 R47 R48 R56 R50 R55 R52 R54 R58 R33 R35 R32 R44
P101 P102 P103 P104
CR8 CR15 CR21 CR22 CR20 CR19 CR18 CR17 CR32 CR39
CR45 CR46 CR44 CR43 CR42 CR41 CR56 CR53 CR55 CR50 CR49 CR62 CR60 CR59
CR77 CR78 CR76 CR79 CR67 CR74 CR80 CR73
IC2 IC4 IC5 IC6 IC7 R9 R7 R10 R12 R14 R23 R39 R37 R31
CR86 CR87 CR85 CR88 CR92 CR83 CR90 CR97
SW1 SW2 SW3 R1 SW4 SW5 SW6 R4 8' SW7 4' SW8 R8 16' SW9 8' SW10 R11
VAR SW11 PRE SW12 R13 R22 VAR SW13 PRE SW14 R38 FREE SW20 LOCK SW19 R36 VAR SW17 PRE SW18 R30 VAR SW15 PRE SW16
L1 L2 L3 L4 L5 L6 L7 L8 L9 L10 L11 L12 L13 L20 L19 L18 L16 L17 L14 L15

FIGURE 21 LEFT HAND CONTROL PRINTED CIRCUIT CL BOARD 10 (POLYMOOG)

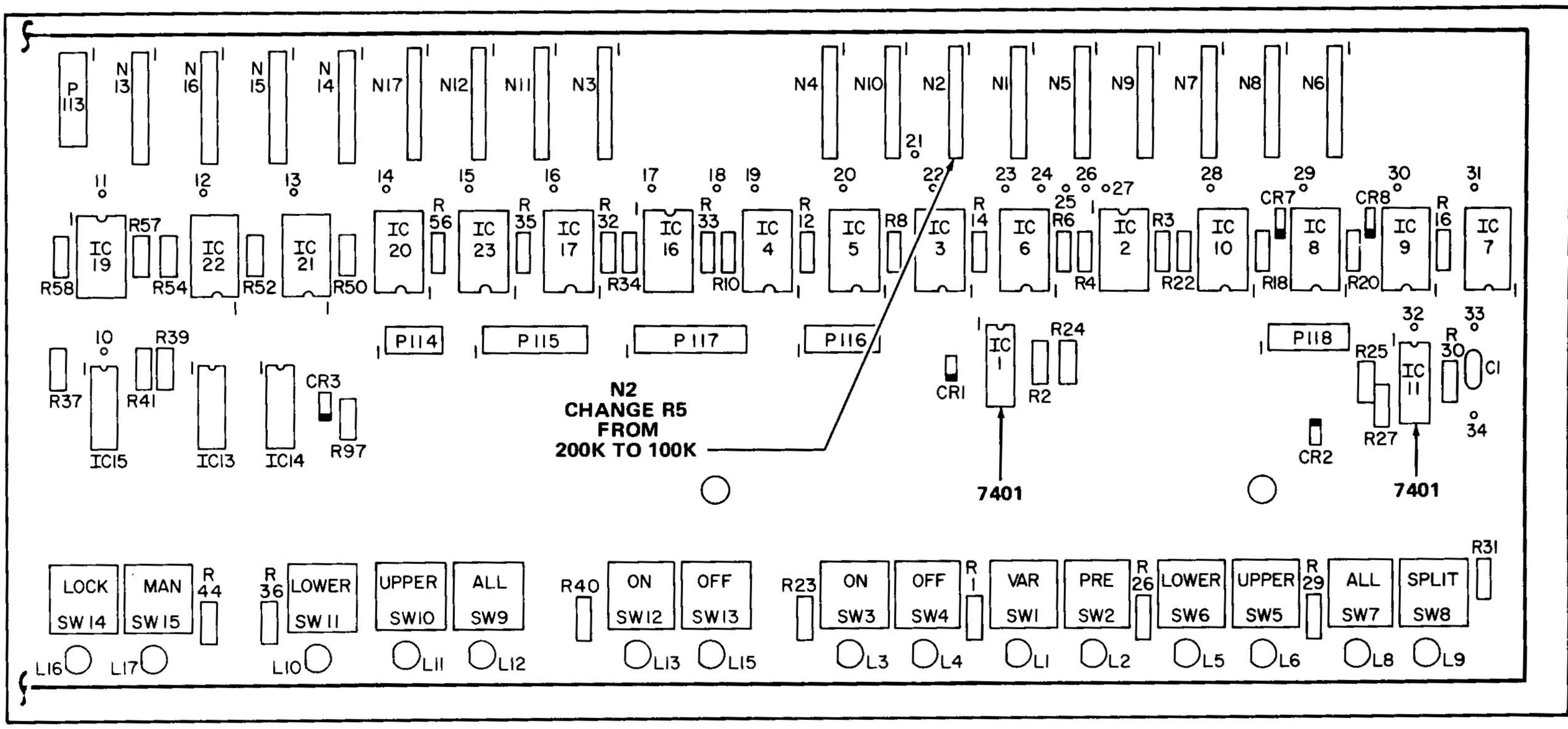

P113
N13
N16
N15
N14
N17
N12
N11
N3
N4
N10
N2
N1
N5
N9
N7
N8
N6
IC19
IC22
IC21
IC20
IC23
IC17
IC16
IC4
IC5
IC3
IC6
IC2
IC10
IC8
IC9
IC7
R58
R57
R54
R52
R50
R56
R35
R32
R34
R33
R10
R12
R8
R14
R6
R4
R3
R22
R18
R20
R16
CR7
CR8
P114
P115
P117
P116
P118
IC15
IC13
IC14
R37
R39
R41
CR3
R97
IC1
CR1
R24
R2
R25
IC11
R27
R30
C1
CR2
N2
CHANGE R5
FROM
200K TO 100K
7401
7401
LOCK SW14
MAN SW15
R44
R36
LOWER SW11
UPPER SW10
ALL SW9
R40
ON SW12
OFF SW13
R23
ON SW3
OFF SW4
R1
VAR SW1
PRE SW2
R26
LOWER SW6
UPPER SW5
R29
ALL SW7
SPLIT SW8
R31
L16
L17
L10
L11
L12
L13
L15
L3
L4
L1
L2
L5
L6
L8
L9

FIGURE 22 RIGHT HAND CONTROL AND MASTER PRESET PRINTED CIRCUIT CR BOARD 11 (POLYMOOG)

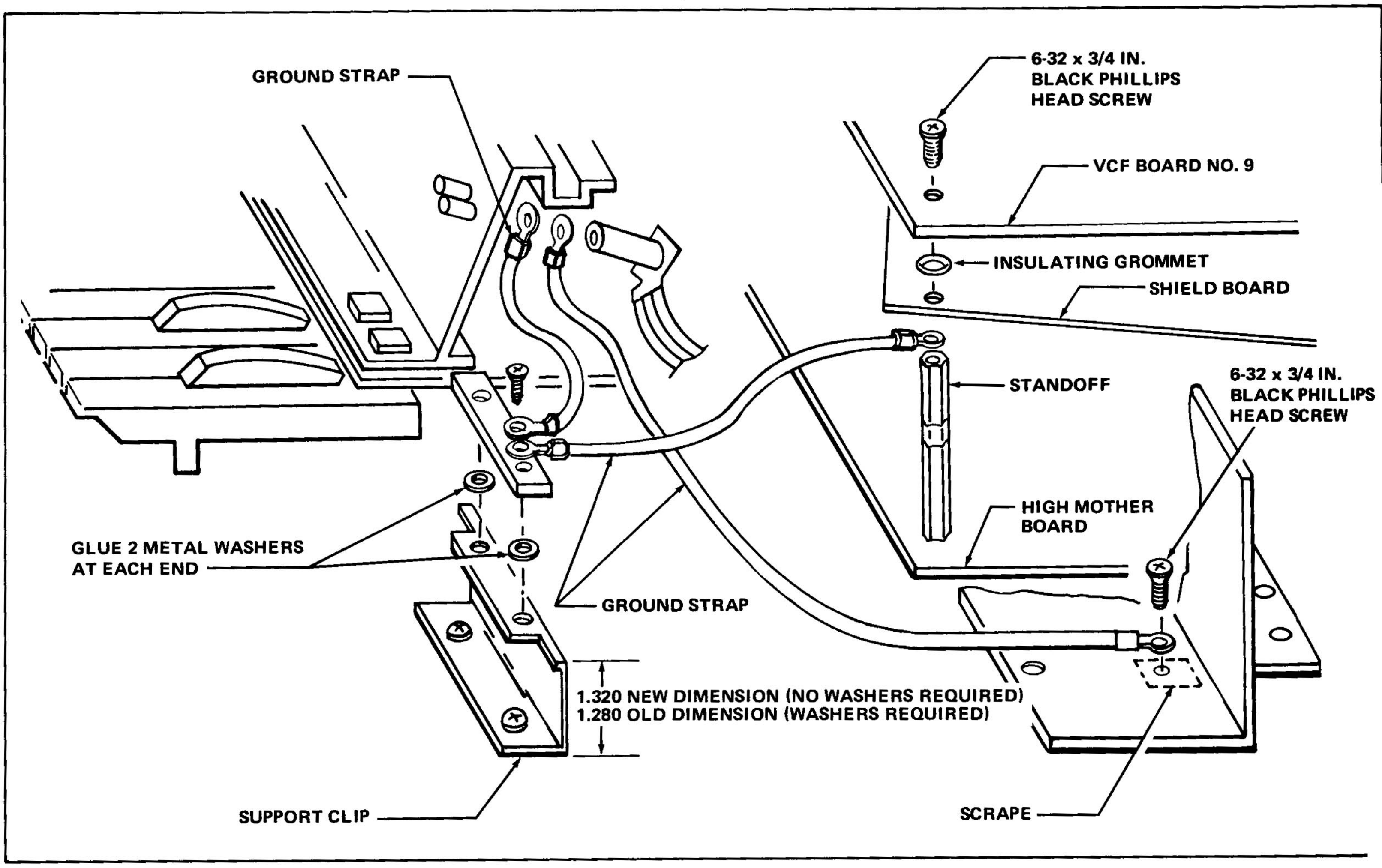

GROUND STRAP
6-32 x 3/4 IN.
BLACK PHILLIPS
HEAD SCREW
VCF BOARD NO. 9
INSULATING GROMMET
SHIELD BOARD
STANDOFF
6-32 x 3/4 IN.
BLACK PHILLIPS
HEAD SCREW
HIGH MOTHER
BOARD
GLUE 2 METAL WASHERS
AT EACH END
GROUND STRAP
1.320 NEW DIMENSION (NO WASHERS REQUIRED)
1.280 OLD DIMENSION (WASHERS REQUIRED)
SUPPORT CLIP
SCRAPE

FIGURE 24 GROUND STRAP INSTALLATION (POLYMOOG)

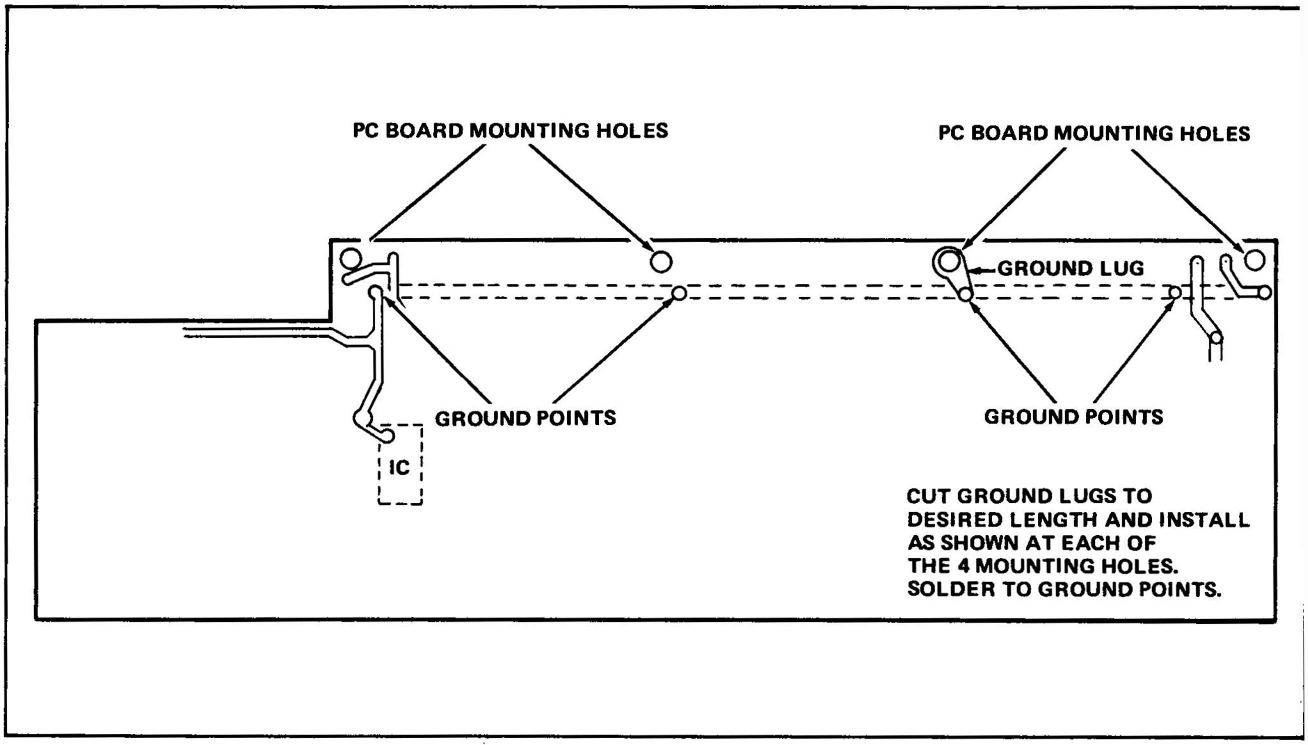

PC BOARD MOUNTING HOLES
PC BOARD MOUNTING HOLES
GROUND LUG
GROUND POINTS
GROUND POINTS
IC
CUT GROUND LUGS TO DESIRED LENGTH AND INSTALL AS SHOWN AT EACH OF THE 4 MOUNTING HOLES. SOLDER TO GROUND POINTS.

FIGURE 23 RIGHT HAND CONTROL BOARD - BOTTOM VIEW (POLYMOOG)

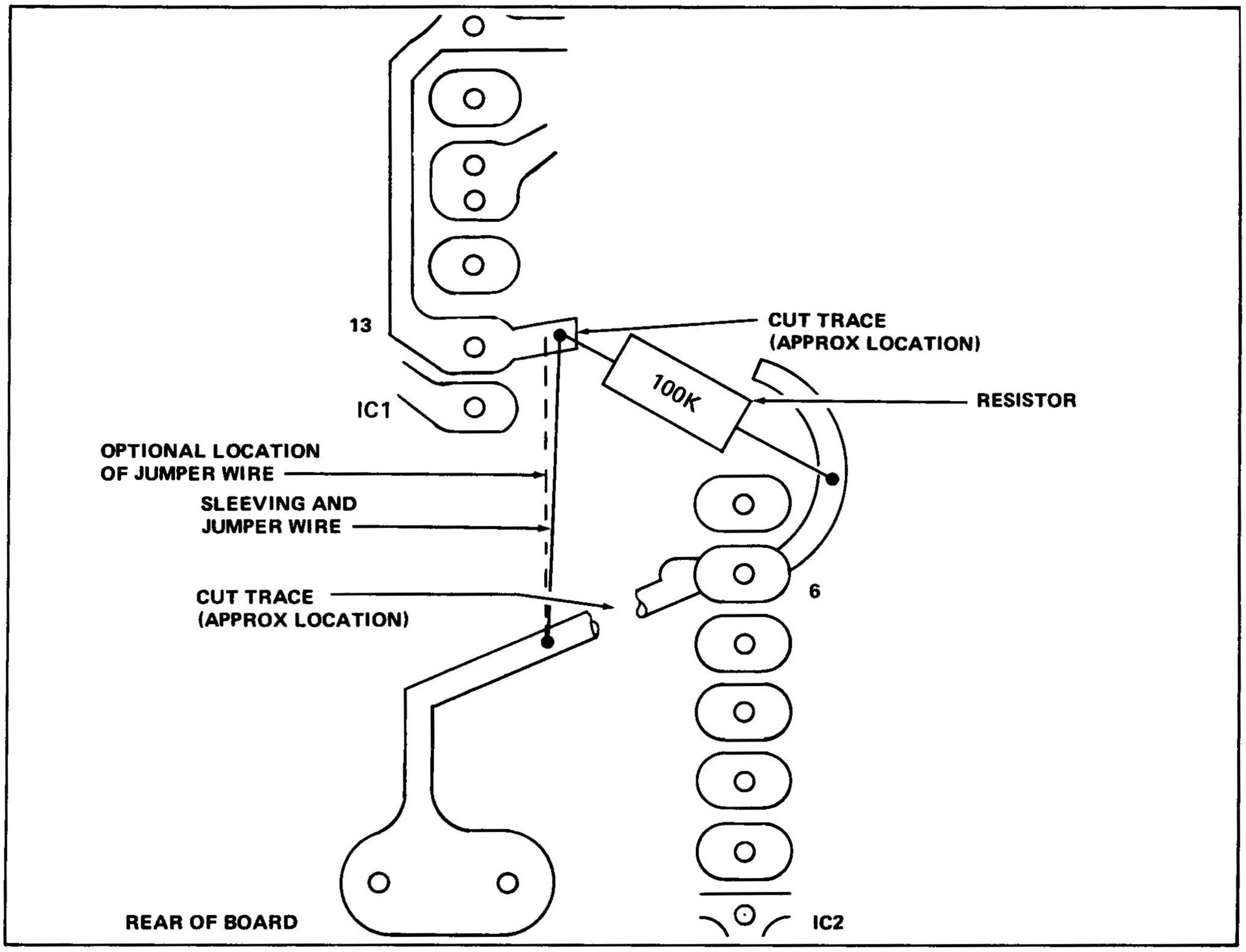

13
IC1
CUT TRACE (APPROX LOCATION)
100K
RESISTOR
OPTIONAL LOCATION OF JUMPER WIRE
SLEEVING AND JUMPER WIRE
CUT TRACE (APPROX LOCATION)
6
REAR OF BOARD
IC2

FIGURE 25 RIGHT HAND CONTROL (POLYMOOG)

LOCATION: RIGHT HAND CONTROL BOARD 11. (Continued)

b. Install One Foot Ground Strap With Ground Lugs At Each End. Refer to Figure 24.

Connect one end to the front panel assembly as shown on the right side of the unit.

Remove one of the mounting screws securing the rear panel extrusion to the base of the instrument at the right corner. With emery cloth or appropriate abrasive material, remove the anodizing on the aluminum in the area of the mounting screw to expose the metal. Connect other end to this point and securely tighten the mounting screw. This establishes a "solid" ground to the front panel assembly.

c. Sample And Hold Circuit Reliability Modification. Refer to Figure 25.

Cut the following traces on the back of the board:

Between IC1 pin 13 and IC2 pin 6.
Between IC2 pin 6 and pin 25 of SVVP output.

Attach 100K resistor between IC1 pin 13 and IC2 pin 6.

Add jumper wire from IC1 pin 13 to SWP output (pin 25) with 3/4-inch sleeving.

d. In Conjunction with Sample and Hold Q5 Failure as Described on VCF Board 9 Procedure:

In modulation network (N2) change R5 from 200K to 100K. Refer to Figure 22.

LOCATION: REAR PANEL MODIFICATION FOR SIMULTANEOUS MIX OUTPUTS FROM XLR CONNECTOR AND PHONE JACK. Refer to Figure 26.

a. Remove jumper from XLR BAL MIX output connector S2-2 to MIX jack J10-1 and add a green jumper from S2-1 to J10-3 (ground).

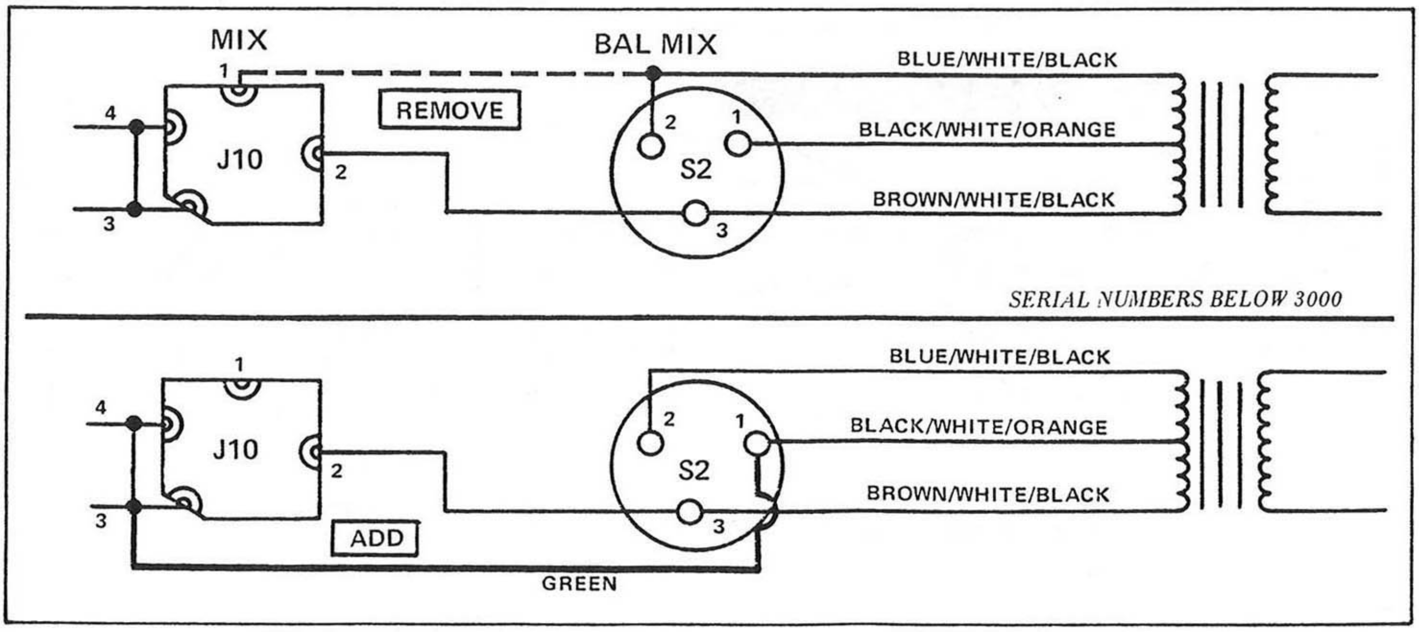

MIX
BAL MIX
1
4
3
2
J10
REMOVE
2
1
S2
3
BLUE/WHITE/BLACK
BLACK/WHITE/ORANGE
BROWN/WHITE/BLACK
SERIAL NUMBERS BELOW 3000
1
4
3
2
J10
ADD
2
1
S2
3
GREEN
BLUE/WHITE/BLACK
BLACK/WHITE/ORANGE
BROWN/WHITE/BLACK

FIGURE 26 MODIFICATION FOR SIMULTANEOUS OUTPUTS (POLYMOOG)

b. To prevent damage to the potentiometer shaft of the external keyboard scale control, shorten it by approximately 1/4-inch (Figure 27). This will ensure that the knob will rest against the mounting hardware and eliminate any stress from damaging the control due to transit or setup of the Polymoog on its rear panel. The control must be removed for this operation. When reassembling the control to the rear panel, add an extra lock washer on the inside as shown if space permits.

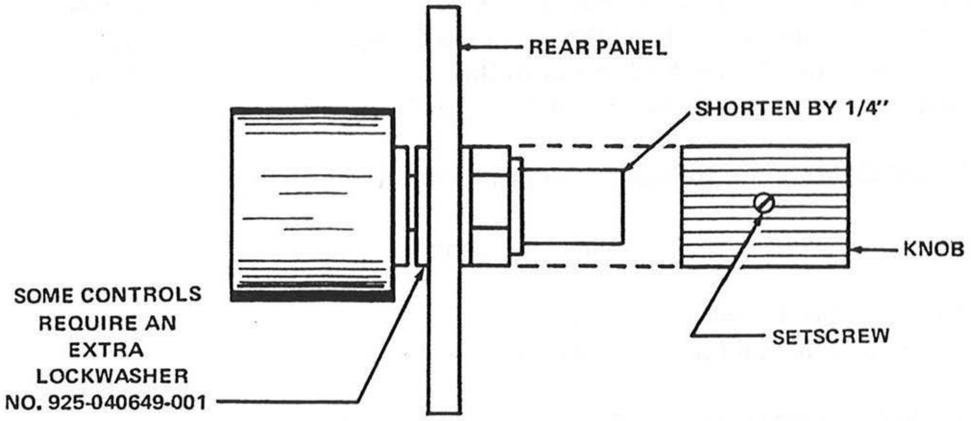

REAR PANEL
SHORTEN BY 1/4"
KNOB
SETSCREW
SOME CONTROLS REQUIRE AN EXTRA LOCKWASHER NO. 925-040649-001

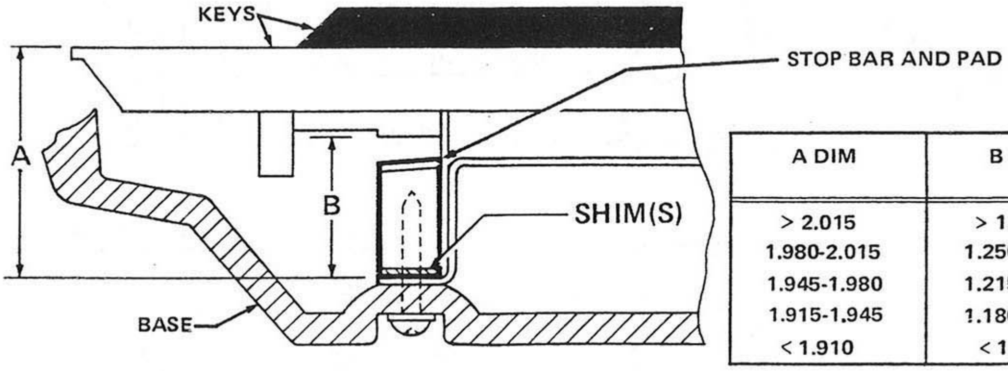
FIGURE 27 EXTERNAL KEYBOARD SCALE CONTROL

LOCATION: KEYBOARD STOP BAR INSTALLATION. Refer to Figure 28.

NOTE

Keyboard may require adjustment before installing a stop bar. Refer to the keyboard adjustment procedure for details.

Unscrew the keyboard from the case and remove the five Tinnerman fasteners attached to the front edge of the keyboard main frame.


KEYS
STOP BAR AND PAD
A
B
SHIM(S)
BASE

A DIM	B DIM	NO. OF SHIMS REQ'D. (.030)
> 2.015	> 1.285	4
1.980-2.015	1.250-1.285	3
1.945-1.980	1.215-1.250	2
1.915-1.945	1.180-1.215	1
< 1.910	< 1.180	0

NOTE: DELETE TINNERMAN FASTENERS. ADD STOP BAR (978-042580-001) WITH FELT PAD. ADD REQUIRED NUMBER OF SHIMS.

FIGURE 28 KEYBOARD CROSS SECTION

Place one shim on the bottom of the keyboard subassembly where each Tinnerman was removed. This prevents the keys from hitting the case.

Add the stop bar to the keyboard main frame and note that the surface marked FRONT must face outward. Also the felt pad must be in up position.

Add shims between the stop bar and mounting holes as follows:

> Depress a white key in the area of a mounting hole.
>
> Bring stop bar up until it touches the depressed key.
>
> Remove paper backing and stick the required number of shims between the stop bar and keyboard frame.

NOTE

Do not over-shim the keyboard stop bar. If a shim prevents the key from traveling all the way down, problems with dynamics will result.

LOCATION: MODULATOR CARDS. Refer to Figure 29.

To improve the dynamics of the keyboard, pad modulator printed circuit boards that sound too loud or too soft. Use the PIANO Preset No. 2 DIRECT output with OCTAVE BALANCE sliders at maximum and also press each key very softly for this test. This adjustment should be performed only after verification of proper supply voltages (+15, -15, +4.85, -5.5), keyboard dynamic adjustments and the keyboard contacts have been adjusted and cleaned as outlined in the service notes.

Using a dB meter, scope, capacitor substitution box, resistor substitution box, and monitor amplifier, add capacitor "C3" to increase the volume (typical values of mylar capacitors are 0.01, 0.022 and 0.033uf maximum) or add resistor "R14" to decrease the volume (typical values are ∞ to 330K). Obtain parts locally for this modification or order a complete set of modulator cards under part number.

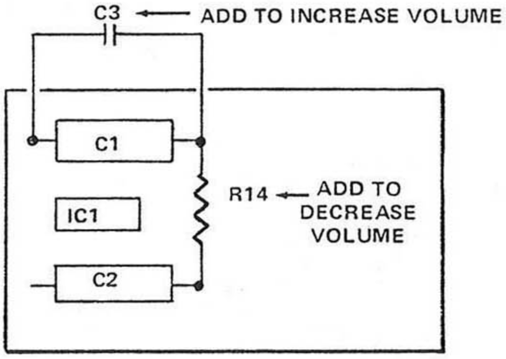


FIGURE 29 MODULATOR CARD (POLYMOOG AND POLYMOOG KEYBOARD)

LOCATION; REAR PANEL STATIC PROTECTION.

Add a 2.7uf tantalum capacitor across SUSTAIN jack (– side to tip, + side to ring).

Install a 10K resistor in series with the BASS output jack (shielded wire).

Use one inch shrink tubing to protect the solder connector.
Add a .01 disc capacitor at the "Bass Output" jack between pin 3 (orange wire) and ground.

Add a 0.001 disc capacitor across MAIN OUTPUT jack between output and ground.

LOCATION: LEFT HAND CONTROL BOARD 10 STATIC PROTECTION. Refer to Figure 30.

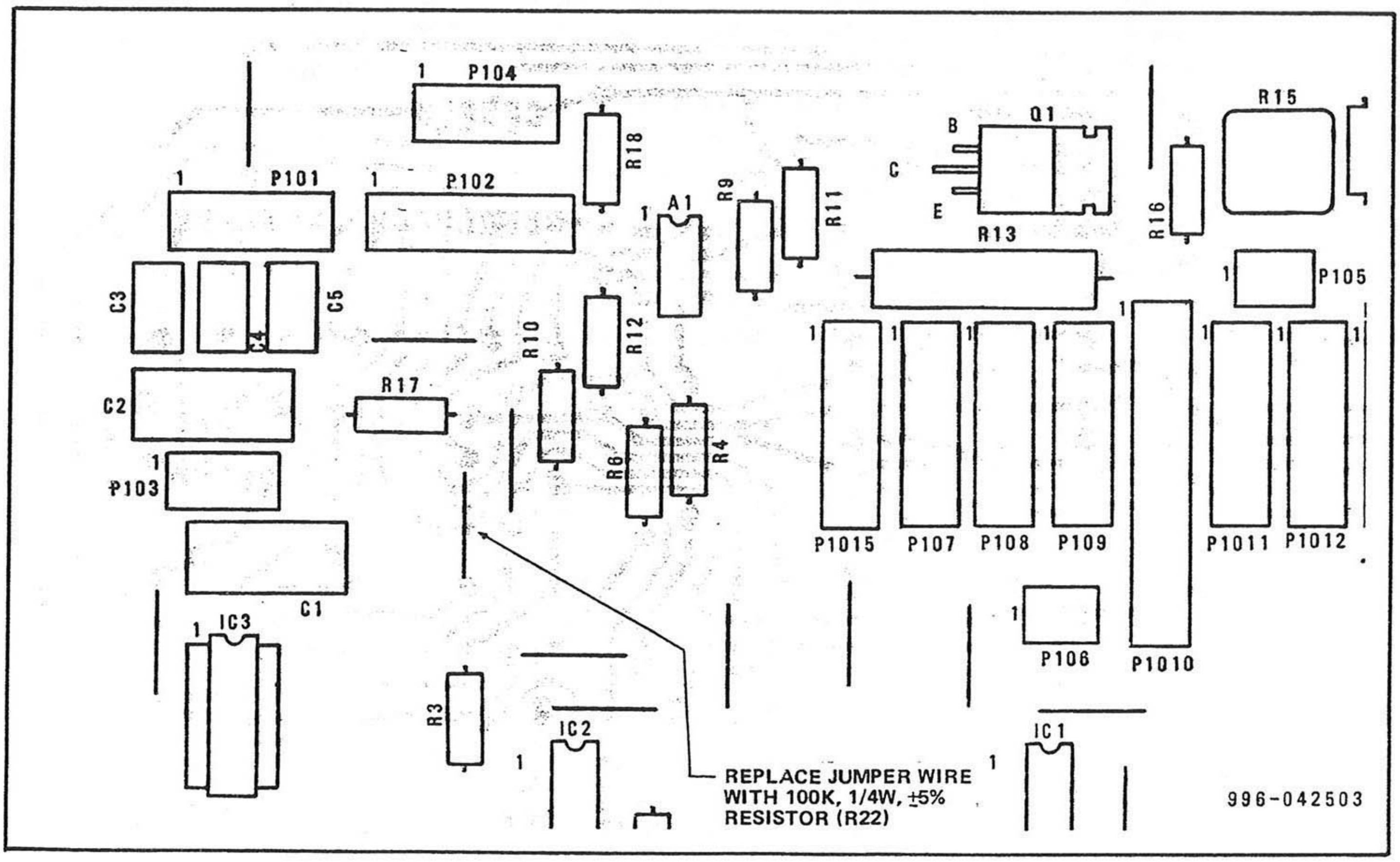
Replace jumper wire with 100K resistor R22.

LOCATION: AUDIO BOARD 8 STATIC PROTECTION. Refer to Figure 31.

Replace jumper wire with a 1 megohm resistor R59.

a. Noise Reduction.

Add a 10K resistor R58 with sleeving between the top of R37 and the bottom
R38.


1 P104
R18
1 P101
1 P102
R9
R11
B
Q1
C
E
R13
R15
R16
1 A1
C3
C4
C5
R10
R12
1 P105
C2
R17
R6
R4
1
P103
1 P1015
1 P107
1 P108
1 P109
1 P1010
1 P1011
1 P1012
C1
1 IC3
1 P106
R3
1 IC2
1 IC1
996-042503

REPLACE JUMPER WIRE WITH 100K, 1/4W, ±5% RESISTOR (R22)

FIGURE 30 LEFT HAND CONTROL CL BOARD 10 (POLYMOOG KEYBOARD)

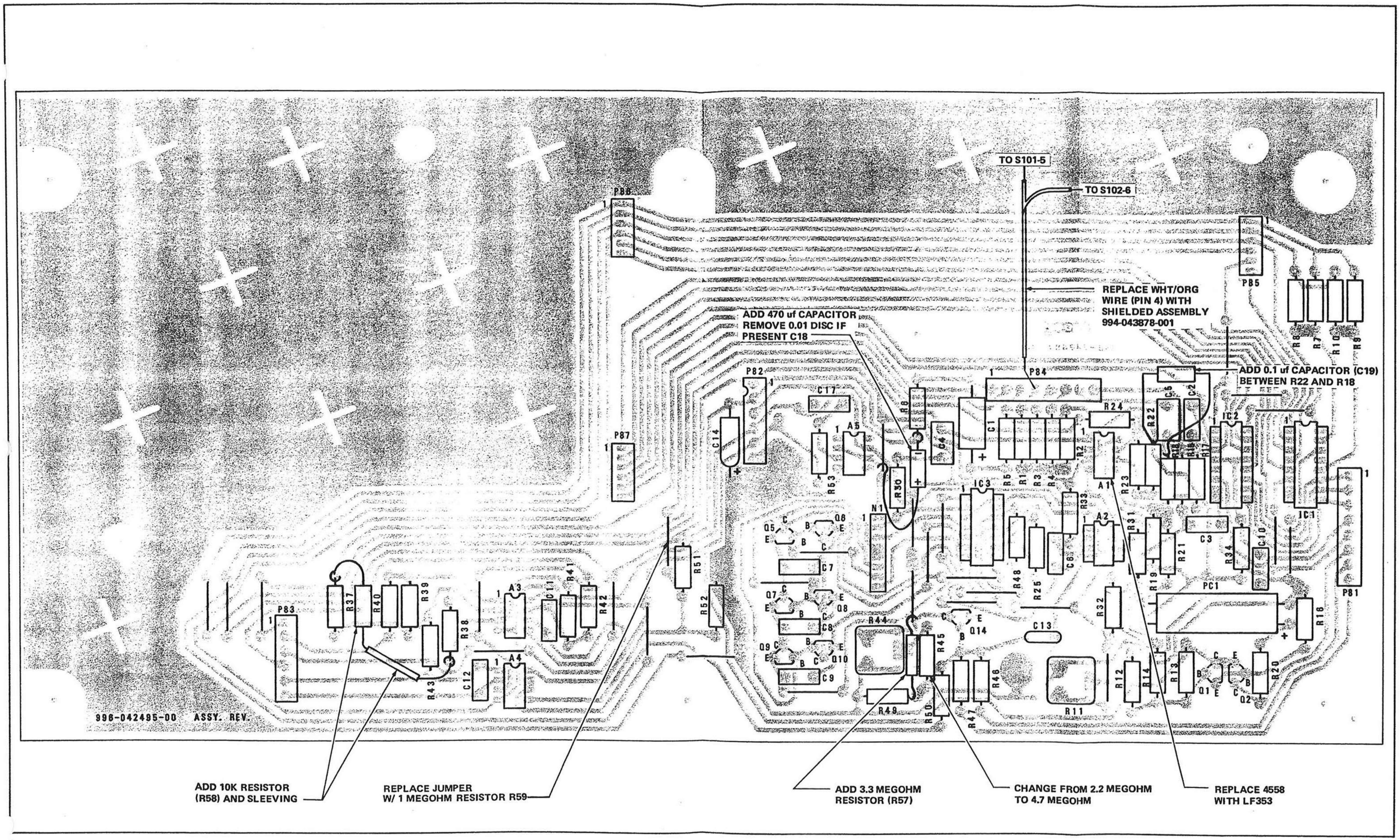

TO S101-5
TO S102-6
REPLACE WHT/ORG WIRE (PIN 4) WITH SHIELDED ASSEMBLY 994-043878-001
ADD 470 uf CAPACITOR REMOVE 0.01 DISC IF PRESENT C18
ADD 0.1 uf CAPACITOR (C19) BETWEEN R22 AND R18
996-042495-00 ASSY. REV.
ADD 10K RESISTOR (R58) AND SLEEVING
REPLACE JUMPER W/ 1 MEGOHM RESISTOR R59
ADD 3.3 MEGOHM RESISTOR (R57)
CHANGE FROM 2.2 MEGOHM TO 4.7 MEGOHM
REPLACE 4558 WITH LF353
P86
P85
P84
P82
P87
P83
P81
PC1
IC1
IC2
IC3
A1
A2
A3
A4
A5
N1

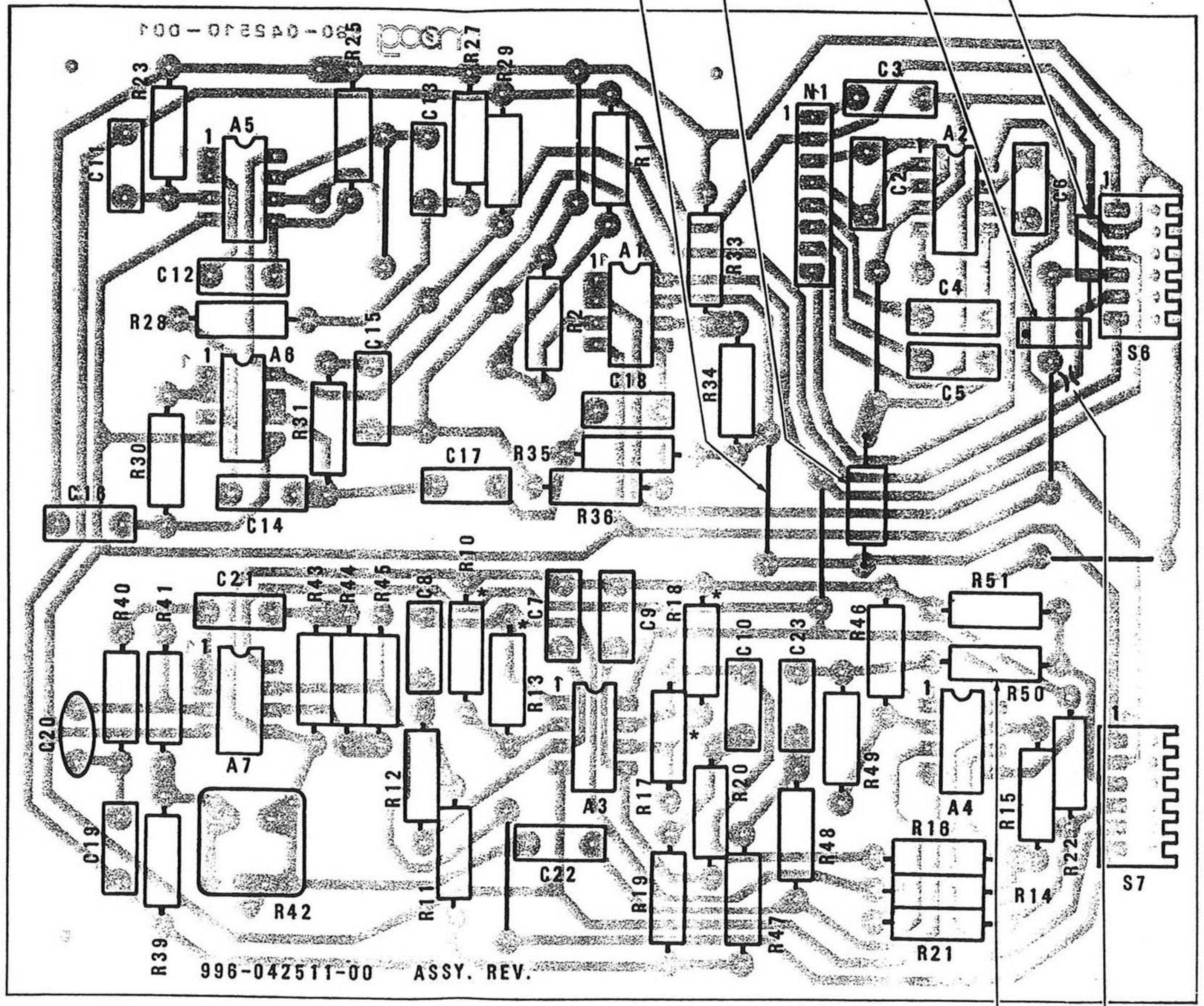
FIGURE 31 AUDIO PRINTED CIRCUIT TC BOARD 8 (POLYMOOG KEYBOARD)

DRILL 2 HOLES AND ADD .033uf CAPACITOR C25

ADD R38 (10K)

DRILL 2 HOLES AND
ADD R52 (10K)

REMOVE JUMPER AND INSTALL
R37 (10K)



080-042510-001
R23
R25
R27
R29
C11
A5
C13
R1
N1
C3
A2
C2
C6
S6
C12
A1
R2
R33
C4
R28
C15
C18
C5
A6
R31
R34
R30
C17
R35
C16
C14
R36
R10
C21
R40
R41
R43
R44
R45
C8
C7
C9
R18
C10
C23
R46
R51
R13
R50
C20
A7
R12
A3
R17
R20
R49
A4
R15
R22
S7
C19
R42
R11
C22
R19
R47
R48
R16
R14
R21
R39
996-042511-00 ASSY. REV.

* COMPONENTS CHANGED TO 1% TOLERANCE

R10 & R17 = 22.1K 853-422202-031
R13 = 39.2K 853-423902-031
R18 = 12.1K 853-421202-031

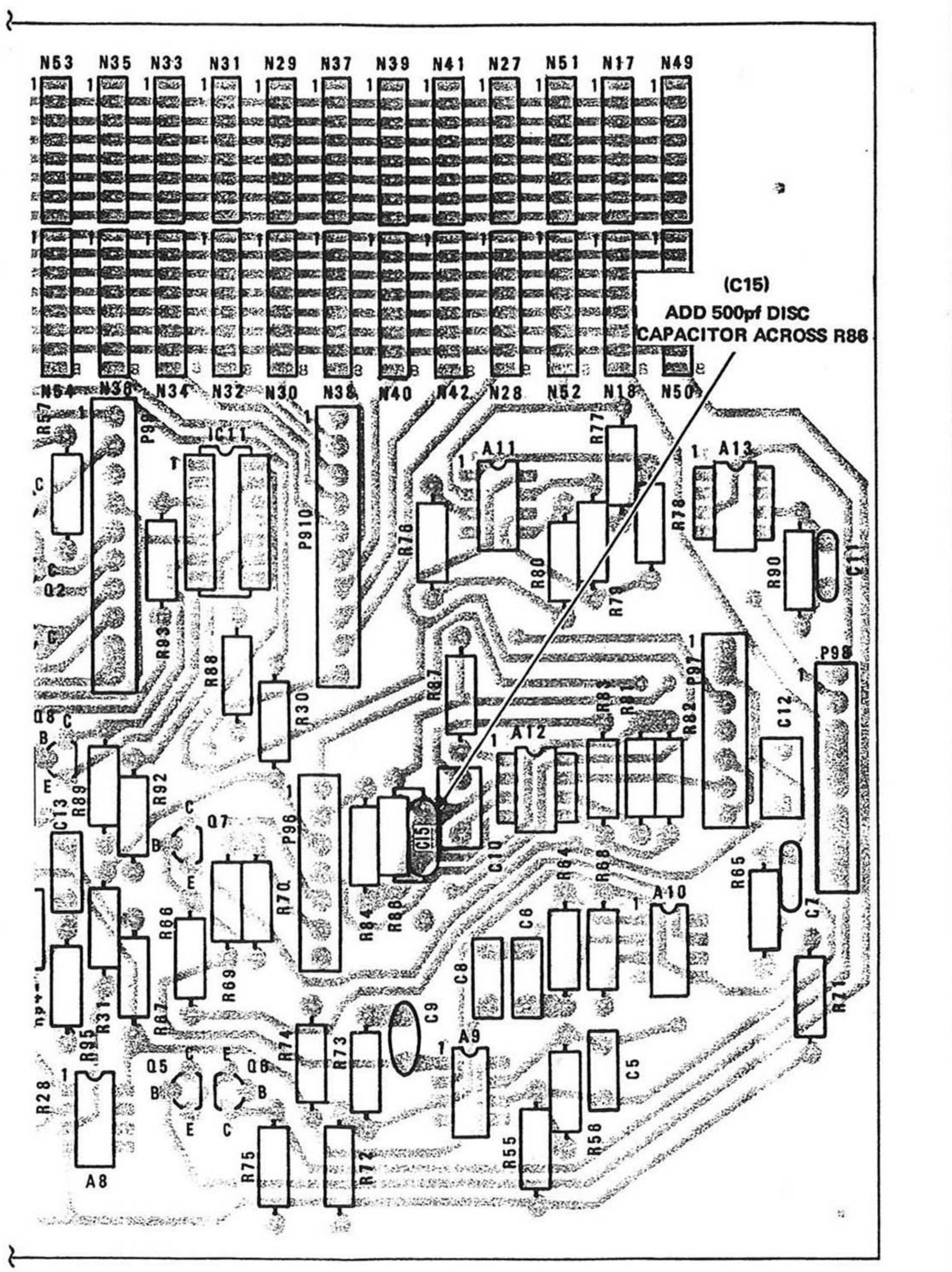
S141-5	W/BL
S141-4	RED
S141-3	BLK
S141-2	W/YEL
S141-1	VIOLET

REMOVE R50 AND INSTALL
C26 (0.039 uf POLYESTER
CAPACITOR)

CUT TRACE (FOIL SIDE)

FIGURE 32 FILTER BOARD TC BOARD 8 (POLYMOOG KEYBOARD)

(C15)
ADD 500pf DISC
CAPACITOR ACROSS R86



N53
N35
N33
N31
N29
N37
N39
N41
N27
N51
N17
N49
N54
N36
N34
N32
N30
N38
N40
N42
N28
N52
N18
N50
IC11
P9
P910
A11
A13
R77
R76
R78
R80
R79
R90
C11
Q2
R93
R88
R30
R87
P97
P98
Q8
R89
R92
Q7
P96
A12
R82
C12
C13
R70
R84
R86
C15
C10
R94
R68
R65
A10
C7
R66
R69
R67
R31
R95
C9
C8
C6
R74
R73
A9
R71
Q5
Q6
R28
C5
A8
R75
R72
R55
R56

FIGURE 33 PROGRAM CONTROL TC BOARD 9 (POLYMOOG KEYBOARD)

LOCATION: AUDIO BOARD 8 STATIC PROTECTION (Continued)

Add a 470uf 16V electrolytic capacitor C18. Connect negative side to bottom of R6 and plus side to jumper as shown. Tack down with RTV. (Remove 0.01uf capacitor in same position if present.)

Replace A1 with an LF 353 IC instead of a 4558.

Add 0.1uf capacitor C19 between R22 and R18.

Replace white/orange wire between S101-5 and S84-4 with shielded cable assembly 994-043878-001. Connect shield of this assembly to S102-6.

b. Center and Decrease Range of R44 Trim.

Change R45 from 2.2 megohm to 4.7 megohm.

Add 3.3 megohm R57 between right side of R49 and jumper wire.

NOTE

After performing this modification, R44 must be recalibrated.

LOCATION: FILTER BOARD 1. Refer to Figure 32.

a. Update Filter Response Curves.

Replace R10 and R17 with 22.1K ± 1% resistors.

Replace R13 with a 39.2K ± 1% resistor.

Replace R18 with a 12.1K ± 1% resistor.

Replace jumper with 10K R37.

Drill 2 holes and add 10K R52.

Drill 2 holes and add 0.033uf C25. Cut trace as indicated.

Add 10K R38 as indicated.

b. Eliminate Thump In Preset No. 13.

Remove R50 and install an 0.039uf polyester capacitor C26 as indicated.

LOCATION: PROGRAM CONTROL BOARD 9. Refer to Figure 33.

a. Eliminate Intermittent Keyboard Circuit Oscillation.

Add 500pf disc capacitor C15 across R86.

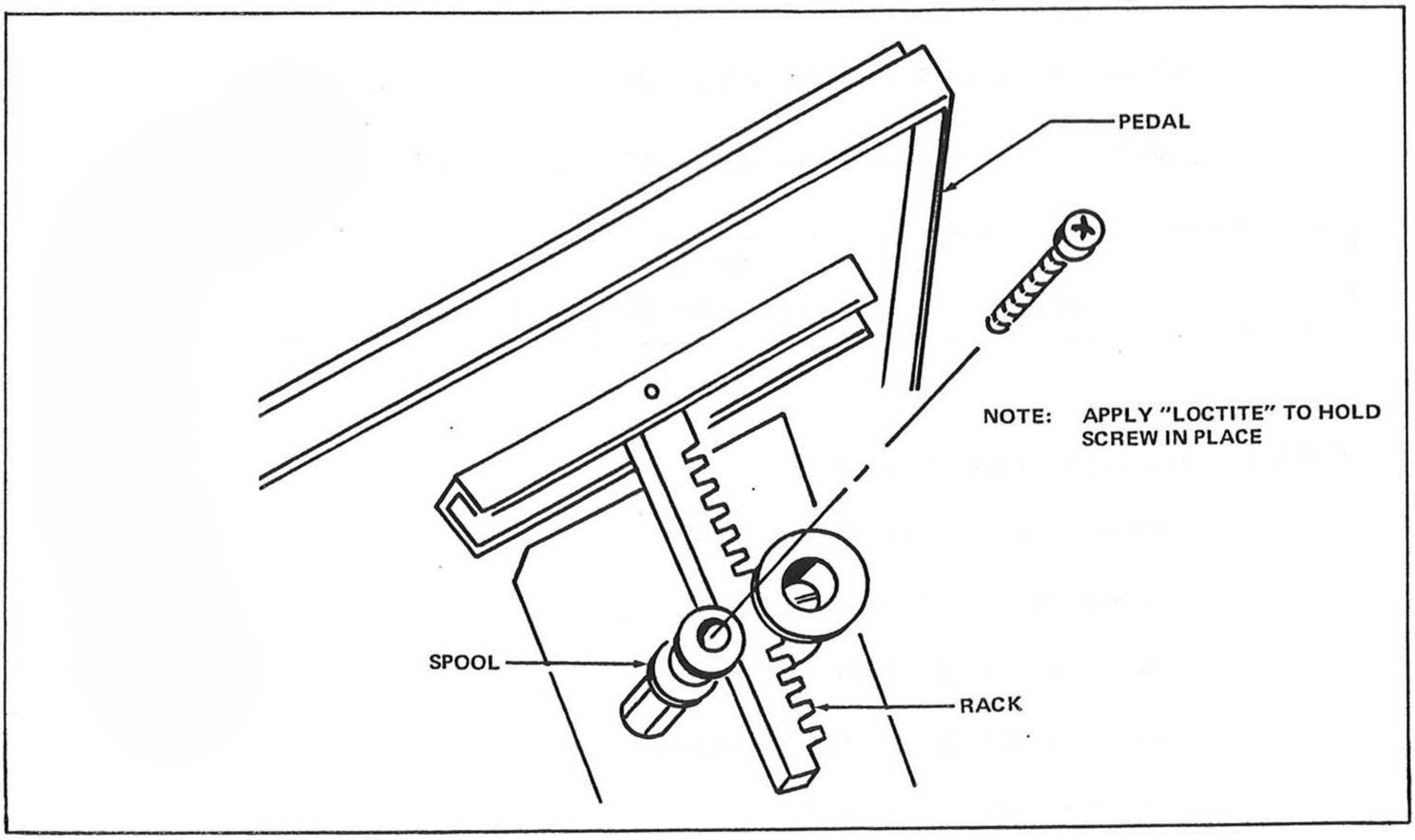
LOCATION: FRONT PANEL SUBASSEMBLY. Refer to Figure 24.

a. To Prevent Contact Between The Keyboard And Left Hand Control Board Causing ICs 1 And 2 To Be Forced From Circuit Board.

Glue 2 flat washers between the support clip and the base mounting bracket only if the support clip dimension is 1.280.

LOCATION: POLYPEDAL

1. To prevent loss of control of the PITCH or SWELL pedals, apply Loctite or similar adhesive to the screw as shown and retighten. Refer to Figure 34.



NOTE: APPLY "LOCTITE" TO HOLD SCREW IN PLACE

FIGURE 34 POLYPEDAL

SERVICE NOTES

POWER SUPPLY RIPPLE

The two most common causes of excessive power supply ripple are as listed below:

Ducati Electrolytic Capacitors located in the unregulated sections of the power supply have exhibited a short life span. The capacitors dry out which increases ripple on the unregulated voltage and eventually the ripple reaches a point at which the regulator cannot function properly. Typical ripple voltages under normal load conditions in a Polymoog Synthesizer are as follows:

- 15 unregulated section 2.0 volts p/p ripple – read from + side of C1 to ground.
+ 15 unregulated section 2.0 volts p/p ripple – read from + side of C4 to ground.
+ 5 unregulated section 1.3 volts p/p ripple – read from + side of C7 to ground.

A Polymoog power supply will stay in regulation even with half of the bridge rectifier diodes open circuited. The instrument operates normally except for a noticeable "dirty" or "modulated" sounding audio output. If any diode fails, it is recommended that all four (4) diodes in the power supply be replaced.

SLIDEPOTS

When replacing an audio slidepot, note that the same slidepot is used in both audio and reverse audio applications. A reverse audio taper is derived by reversing the connections to the element of the slider and mounting the slidepot upside down.

Exercise care when cleaning slidepots – do not insert a spraying nozzle beyond the protective foam padding as damage may result to the carbon element.

NOTE

On Polymoog Synthesizers above serial number 3000, the decay sliders in the loudness contour section were changed from reverse audio to linear tapers. This was initiated for improved resolution of the decay function when the loudness contour section is switched to the variable state.

BROKEN KEYCOMB – (Key Pops Up)

This situation requires the replacement of the keycomb which holds the keys in place. There are two keycombs on each keyboard subassembly. One supports 34 keys while the other supports 37 keys. After removing the keyboard subassembly from the unit, tape a stop bar to the top of the keyboard to hold all the white keys down. Place the keyboard face down on a flat, cloth covered surface.

CAUTION

Do not raise the keyboard off the cloth covered surface until all repairs are completed. This ensures that the black keys remain in position during keycomb replacement.

Drill out the rivets securing the broken keycomb. Remove and carefully replace the keycomb and rivet in place.

NOTE

This condition is preventable with the installation of a stop bar for older instruments. Refer to the stop bar instruction procedure in this bulletin.

POLYMOOG AND POLYMOOG KEYBOARD CONTACT ADJUSTMENT PROCEDURE (BELOW SERIAL NO. 3456)

Mechanical tolerances in Polymoog keyboards are very critical for they directly affect keyboard dynamics.

Below is the procedure for properly adjusting the mechanics of the keyboard in field service. Care must be exercised when making these adjustments to prevent damage to the gold plated spring contacts and buss bars. Avoid touching these parts with your fingers to prevent contamination of the gold plated surfaces. It is estimated that this procedure will require an average time of 1.5 hours to complete.

a. Remove the keyboard from the instrument.

b. Place keyboard face down on a table covered with a soft cloth to prevent the keys from being scratched.

c. Using the keyboard adjusting tool as shown in Figure A, line up all "E"s and "D^6" so that the rear spring contact is 1/32 inch (.79 millimeter) behind the rear edge of the concave cutout in the plastic buss bar holders as shown in Figure B. This may be accomplished by extending a taut string across the buss bar holders at the measured distance.

d. Flip keyboard over to the normal playing position. Align all other white keys to be level with the reference keys adjusted in step c. Refer to Figure C. Looking along the front edge of the keyboard, align all black keys so that the lower angle on the black key's front just peeks over the white key surface.

e. Insure that all rocker arms on the underside of the keyboard are in line with each other with no keys depressed.

NOTE

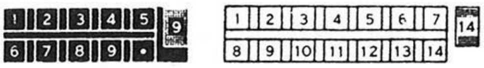
On some black keys the lead weight may be thicker than others. This results in improper contact spacing when the black key is visually lined up as in step d. An out-of-line rocker arm will indicate this problem. Replacing the problem weighted key will correct this condition, but realignment will be necessary.

f. Referring to Figure A, use a .120 inch (3.1 millimeters) gauge and carefully adjust each staple by bending the tube retainers as needed in order that the gauge glides smoothly between the staple and recess buss. A 1/8 inch or number 31 drill bit shank maybe used.

CAUTION

These parts are gold plated and pliers should never contact the staple.

g. Reinstall keyboard, check each note for dynamic response and dirty contacts.



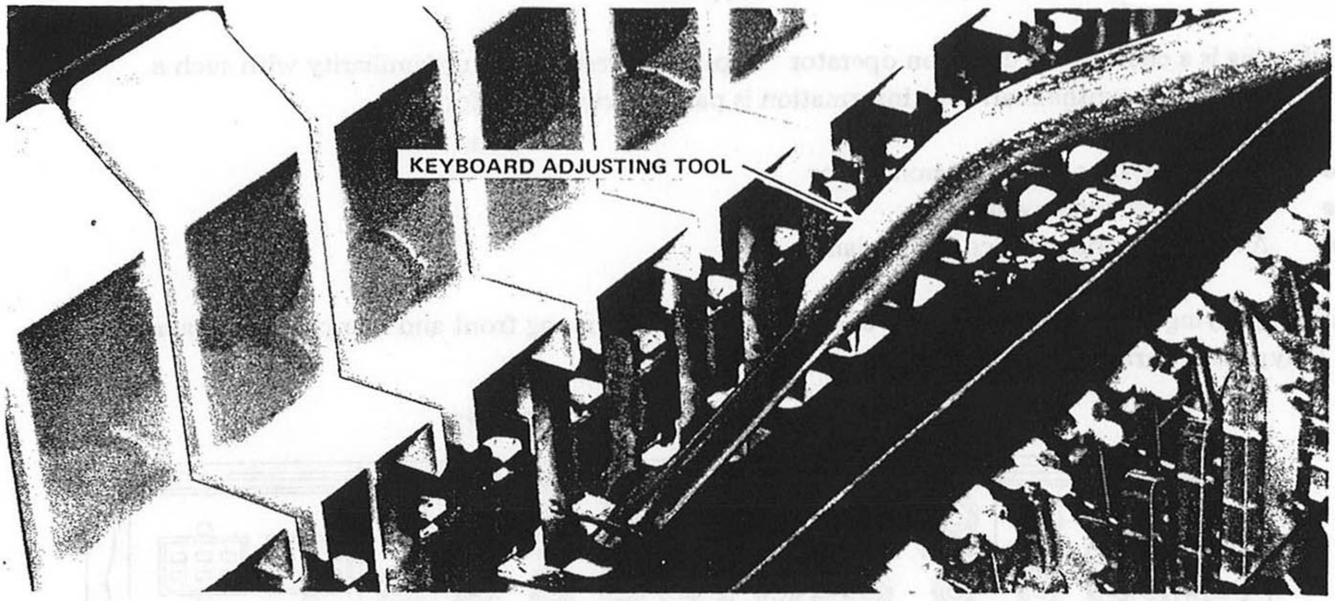

KEYBOARD ADJUSTING TOOL

FIGURE A

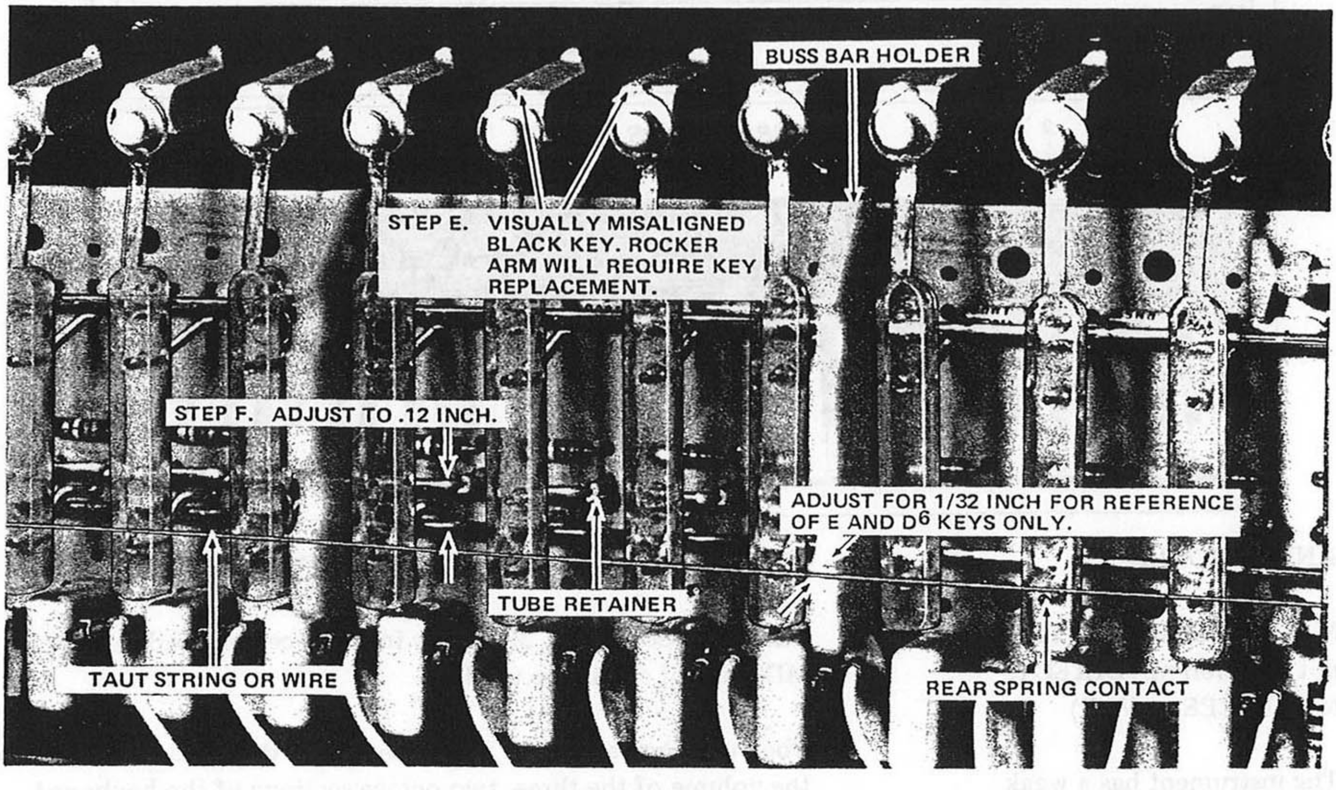

BUSS BAR HOLDER
STEP E. VISUALLY MISALIGNED BLACK KEY. ROCKER ARM WILL REQUIRE KEY REPLACEMENT.
STEP F. ADJUST TO .12 INCH.
ADJUST FOR 1/32 INCH FOR REFERENCE OF E AND D^6 KEYS ONLY.
TUBE RETAINER
TAUT STRING OR WIRE
REAR SPRING CONTACT

FIGURE B

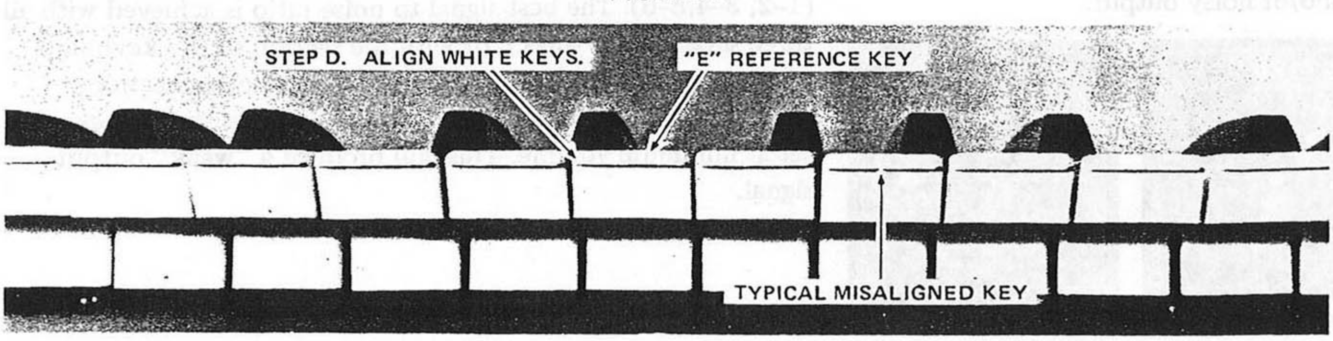

STEP D. ALIGN WHITE KEYS.
"E" REFERENCE KEY
TYPICAL MISALIGNED KEY

FIGURE C

OPERATOR TRAPS (Polymoog Synthesizer and Polypedal)

The following is a checklist of common operator "traps" that result from unfamiliarity with such a complex and flexible synthesizer. This information is particularly useful for:

- A new Polymoog store demonstrator
- A new Polymoog owner and
- A new Polymoog service technician

The accompanying numbered checklist is coordinated with Polymoog front and rear panel diagrams and a Polypedal diagram.

POLYMOOG OPERATOR TRAPS

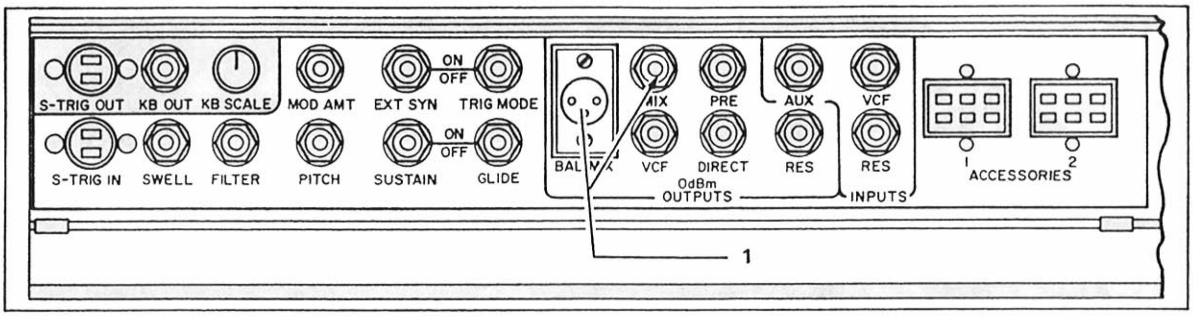
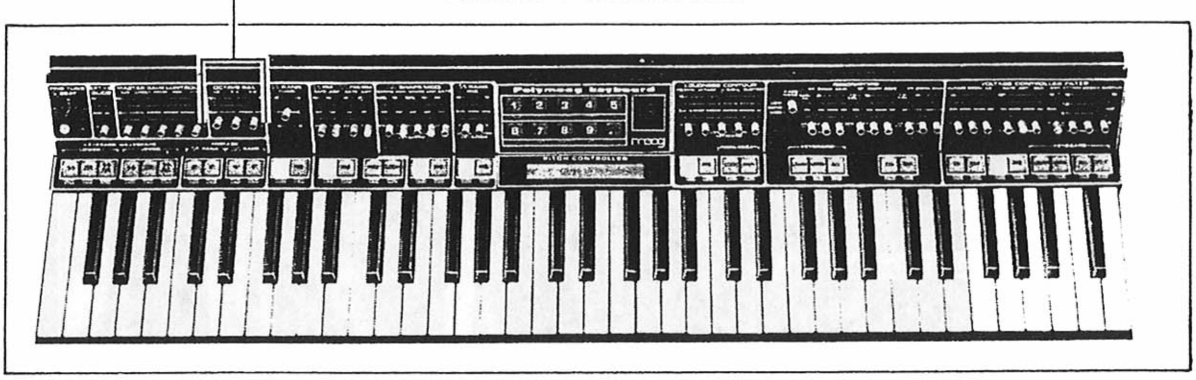

S-TRIG OUT
KB OUT
KB SCALE
MOD AMT
EXT SYN
ON
OFF
TRIG MODE
S-TRIG IN
SWELL
FILTER
PITCH
SUSTAIN
ON
OFF
GLIDE
BAL MIX
MIX
PRE
VCF
DIRECT
0dBm
OUTPUTS
AUX
RES
VCF
RES
INPUTS
1
2
ACCESSORIES
1

FIGURE 1 REAR PANEL



IMAGINED PROBLEM	EXPLANATION OR CORRECTIVE CONTROL SETTING
1. MASTER GAIN CONTROLS not functioning (DIRECT, MODE, RES or VCF)	The Polymoog's BAL MIX (low impedance balanced line) or MIX output should be used.
2. The instrument has a weak and/or noisy output.	The Polymoog's OCTAVE BAL section is designed to control the volume of the three, two octave sections of the keyboard (1-2, 3-4,5-6). The best signal to noise ratio is achieved with all three sliders at 10 (max), or with the section of the keyboard which is to be the loudest set at 10, and the other sections decreased to the desired level. The three sliders should never be set at minimum volume. This will produce a "weak" output signal.

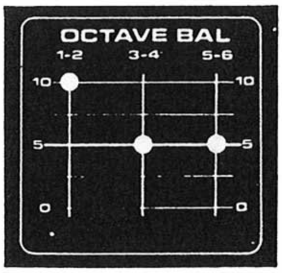

OCTAVE BAL
1-2
3-4
5-6
10
10
5
5
0
0

FIGURE 2

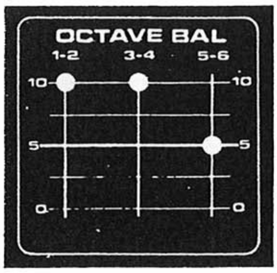
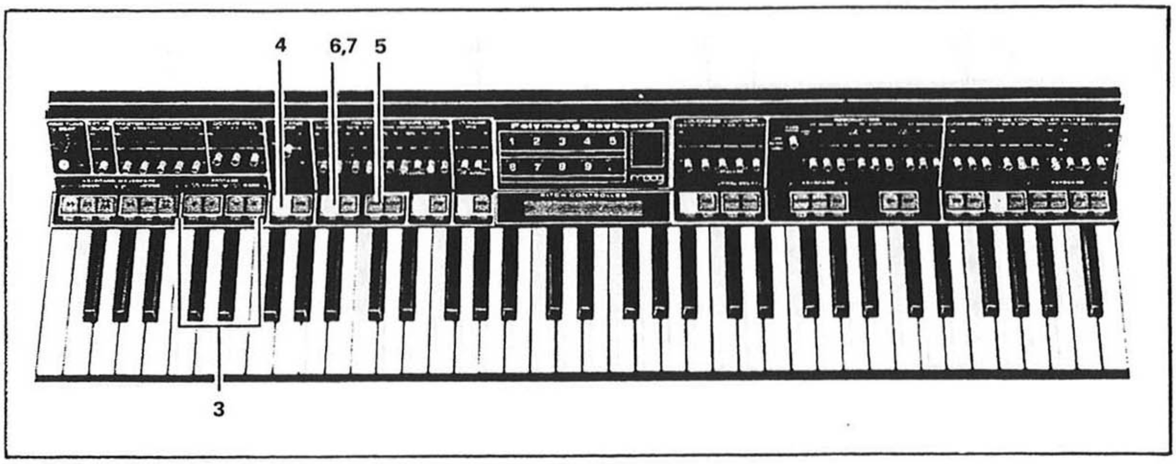

OCTAVE BAL
1-2
3-4
5-6
10
10
5
5
0
0

FIGURE 3

POLYMOOG OPERATOR TRAPS (Continued)



IMAGINED PROBLEM	EXPLANATION OR CORRECTIVE CONTROL SETTING
3. FOOTAGE ◿◿ RANK and FOOTAGE ⎍⎍ RANK controls not operating.	The footage (octave) of the preset voice selected must coincide with the appropriate waveshape. For example, BRASS (Preset No. 8) uses only the sawtooth waveshape. Changing the footage of the square rank will produce no audible effect, since the square waveshape is not on. Refer to the LED's in the Keyboard waveshape section to determine which waveshapes the preset voice uses. If the preset does not use that waveshape, press the button of the waveshape to activate it and then alter the footage for that waveshape.

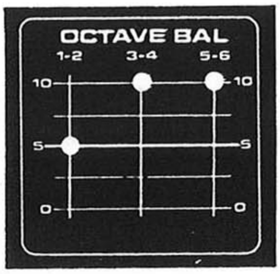


FIGURE 4

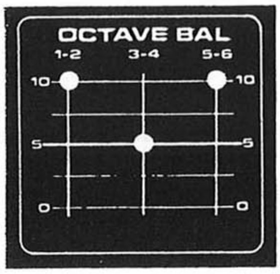
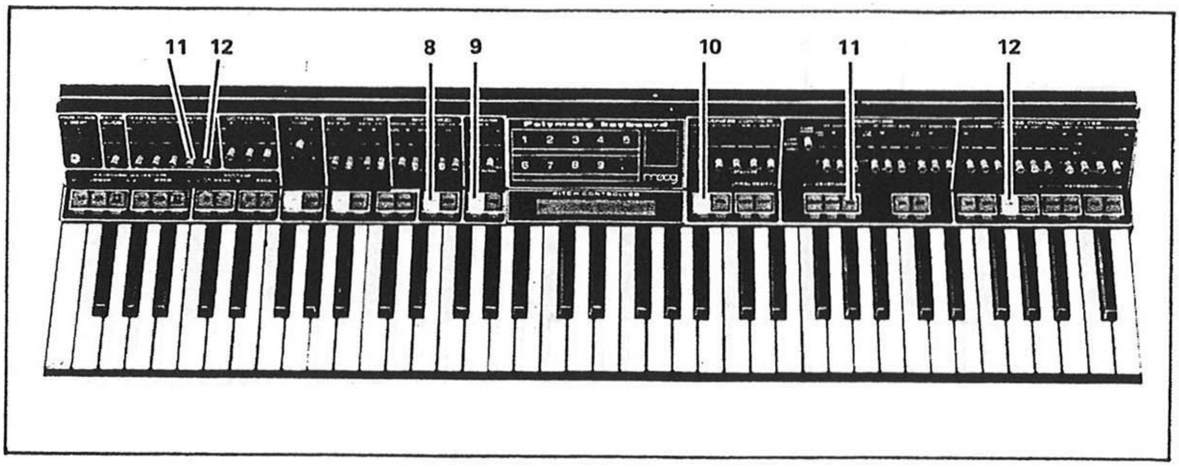


FIGURE 5

IMAGINED PROBLEM	EXPLANATION OR CORRECTIVE CONTROL SETTING
4. ◿◿ RANK TUNE control inoperative.	The VAR button must be pressed to activate this control. The sawtooth waveshape must be on to control its pitch. Refer to the LED's in the keyboard waveshape section. Secondly, both keyboard waveshapes (sawtooth and square) must be on to be able to tune one pitch against another for intervals and the waveshapes must be unlocked by pressing the FREE button for presets 2, 4, 5, 6 and 7.
5. BEAT control not functioning.	The BEAT control finely detunes the square waveshape from the sawtooth. Both waveshapes must be on, and in the case of presets 2, 4, 5, 6 and 7, the FREE button must be pressed to unlock the waveshapes.
6. ◿◿ FM control inoperative.	The VAR button must be pressed. Check if preset used sawtooth waveshape.
7. ⎍⎍ FM/PM control inoperative.	The VAR button must be pressed. Check if preset uses square waveshape.

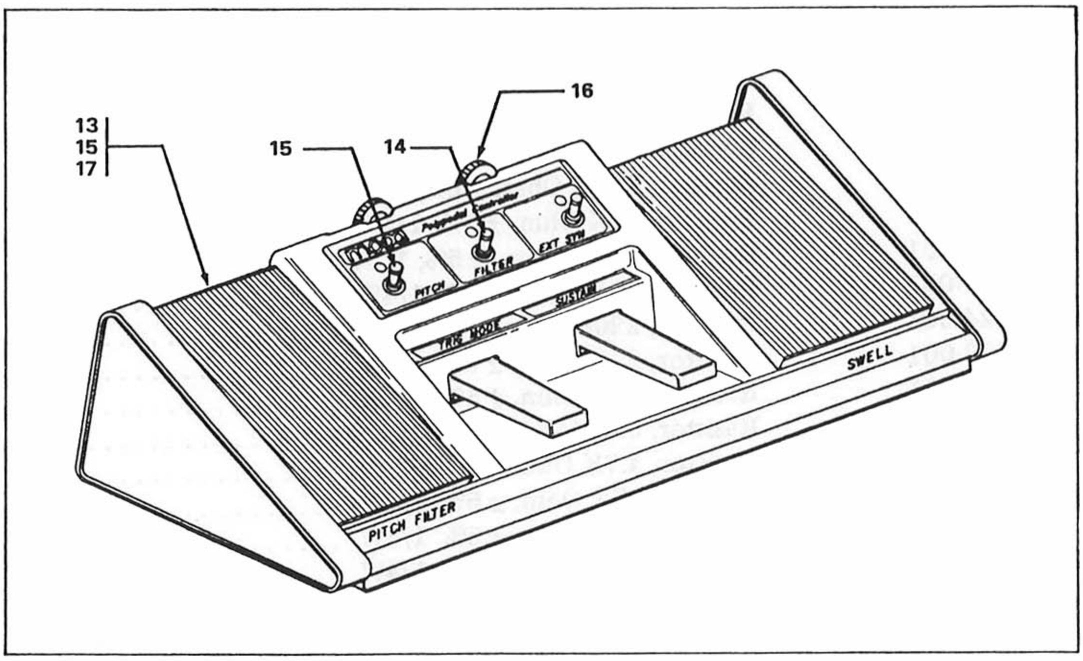
1 2 3 4 5 9
6 7 8 9 •

POLYMOOG OPERATOR TRAPS (Continued)



IMAGINED PROBLEM	EXPLANATION OR CORRECTIVE CONTROL SETTING
8. Square Waveshape Modulation section inoperative.	The VAR button must be pressed. Check if preset uses square waveshape. If the SHAPE sliders are set at maximum 50%, no modulation varies the waveshape from narrow to full. At 50%, the waveshape is starting at full and cannot be made any wider.
9. ◿◿ RANK MIX control not functioning.	This controls the volume of the sawtooth waveshape. The VAR button must be pressed. Check if the preset voice uses sawtooth waveshape.
10. LOUDNESS CONTOUR inoperative.	The VAR button must be pressed. If the ATTACK slider is set higher than the DECAY sliders (with no sustain), no sound will result.
11. RESONATORS section inoperative.	The RESONATOR and MASTER GAIN CONTROLS must be turned up. At zero, no signal from the resonators is present. KEYBOARD ALL button must be pressed to hear the entire keyboard. Make sure the OFF button has not been pressed. The individual RESONATOR GAIN controls must be up for the resonator section to operate. If the EMPHASIS and GAIN sliders in any one section are both at maximum, distortion may occur in the low-pass and band pass modes.
12. VOLTAGE CONTROLLED FILTER section inoperative.	The VCF MASTER GAIN CONTROLS must be raised. At zero, no signal is present. The VAR button must be pressed. Make sure the OFF button has not been pressed. See Polypedal section also.

THE POLYPEDAL AND ITS INTERACTION WITH THE POLYMOOG



IMAGINED PROBLEM	EXPLANATION OR CORRECTIVE CONTROL SETTING
13. VOLTAGE CONTROLLED FILTER CONTOUR is not operating.	The PITCH FILTER pedal must not be at maximum. At maximum, the filter cutoff is at 10 and cannot be contoured.
14. PITCH FILTER is being used to control the filter and no effect is heard.	The FILTER on/off switch must be "on." LED glows when the switch is "on."
15. PITCH FILTER pedal is being used to control pitch.	The PITCH on/off switch must be "on." LED glows when the switch is "on."
16. No pitch change occurs.	A rotary pot controls the pitch-bend range of the pedal. It must be set above zero for pitch change to occur.
17. Signal distortion occurs with use of PITCH PEDAL.	On Polymoogs under serial number 3000, if the pitch pedal and pot are both at maximum, signal distortion can occur. Since the range this cumulative effect produces is extremely high-pitched, in most cases, backing off the rotary pot slightly will not affect musical performance.

PRESET VOICING KIT

PART NO. 997-043991-001

PART NO.	DESCRIPTION	QTY
852-312105-001	Resistor, 1 Megohm, ± 5%, 1/4W	2
852-312114-001	Resistor, 110K Ohm, ± 5%, 1/4W	3
852-312124-001	Resistor, 120K Ohm, ± 5%, 1/4W	1
852-312134-001	Resistor, 130K Ohm, ± 5%, 1/4W	2
852-312153-001	Resistor, 15K Ohm, ± 5%, 1/4W	1
852-312184-001	Resistor, 180K Ohm, ± 5%, 1/4W	3
852-312203-001	Resistor, 20K Ohm, ± 5%, 1/4W	1
852-312224-001	Resistor, 220K Ohm, ± 5%, 1/4W	3
852-312273-001	Resistor, 27K Ohm, ± 5%, 1/4W	5
852-312333-001	Resistor, 33K Ohm, ± 5%, 1/4W	2
852-312335-001	Resistor, 3.3 Megohm, ± 5%, 1/4W	1
852-312472-001	Resistor, 4.7K Ohm, ± 5%, 1/4W	1
852-312473-001	Resistor, 47K Ohm, ± 5%, 1/4W	1
852-312563-001	Resistor, 56K Ohm, ± 5%, 1/4W	2
852-312623-001	Resistor, 62K Ohm, ± 5%, 1/4W	1
852-312823-001	Resistor, 82K Ohm, ± 5%, 1/4W	2
947-042020-102	Capacitor, Ceramic Disc, 0.001uf	1
947-042020-501	Capacitor, Ceramic Disc, 500uf	1

RELIABILITY AND PERFORMANCE KIT

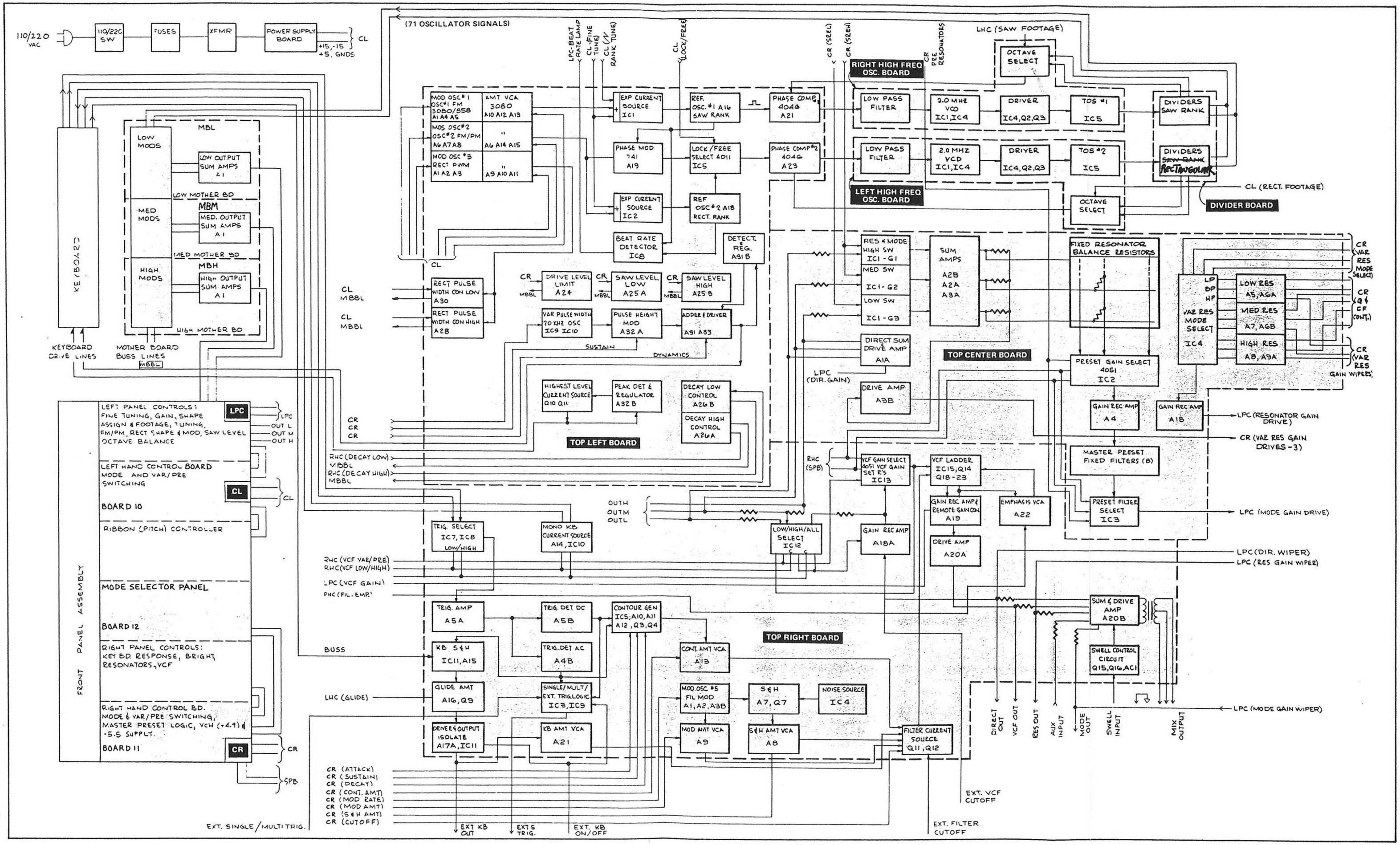
PART NO. 997-043993-001

PART NO.	DESCRIPTION	QTY
852-312101-001	Resistor, 100 Ohm, ± 5%, 1/4W	1
852-312103-001	Resistor, 10K Ohm, ± 5%, 1/4W	8
852-312104-001	Resistor, 100K Ohm, ± 5%, 1/4W	6
852-312105-001	Resistor, 1 Megohm, ± 5%, 1/4W	3
852-312164-001	Resistor, 160K Ohm, ± 5%, 1/4W	1
852-312181-001	Resistor, 180 Ohm, ± 5%, 1/4W	1
852-312182-001	Resistor, 1.8K Ohm, ± 5%, 1/4W	2
852-312202-001	Resistor, 2K Ohm, ± 5%, 1/4W	2
852-312222-001	Resistor, 2.2K Ohm, ± 5%, 1/4W	2
852-312223-001	Resistor, 22K Ohm, ± 5%, 1/4 W	1
852-312242-001	Resistor, 2.4K Ohm, ± 5%, 1/4W	2
852-312272-001	Resistor, 2.7K Ohm, ± 5%, 1/4W	3
852-312302-001	Resistor, 3K Ohm, ± 5%, 1/4W	2
852-312304-001	Resistor, 300K Ohm, ± 5%, 1/4W	3
852-312332-001	Resistor, 3.3K Ohm, ± 5%, 1/4W	2
852-312335-001	Resistor, 3.3 Megohm, ± 5%, 1/4W	1
852-312431-001	Resistor, 430 Ohm, ± 5%, 1/4W	1
852-312472-001	Resistor, 4.7K Ohm, ± 5%, 1/4W	2
852-312475-001	Resistor, 4.7 Megohm, ± 5%, 1/4W	2
852-312753-001	Resistor, 75K Ohm, ± 5%, 1/4W	1
852-312824-001	Resistor, 820K Ohm, ± 5%, 1/4W	1
853-421002-031	Resistor, 10K Ohm, ± 1%, 1/4W	2
853-421212-031	Resistor, 12.1K Ohm, ± 1%, 1/4W	1
853-421872-031	Resistor, 18.7K Ohm, ± 1%, 1/4W	1
853-422003-031	Resistor, 200K Ohm, ± 1%, 1/4W	4
853-422212-031	Resistor, 22.1K Ohm, ± 1%, 1/4W	2
853-423922-031	Resistor, 39.2K Ohm, ± 1%, 1/4W	1
853-424223-031	Resistor, 422K Ohm, ± 1%, 1/4W	1
853-429530-031	Resistor, 953 Ohm, ± 1%, 1/4W	2
903-040489-054	Screw, Machine, 6-32 x 1/2 in.	1
904-040065-003	Washer, Lock, 3/8 in., Int. Tooth	1
904-040601-004	Washer, Fiber Shoulder	1
904-041390-012	Washer, Flat, No. 10	4
910-040301-001	Header, 1 Pin, CIS	1
911-041351-003	Solder Lug	4
914-042582-001	Shim, Stop Bar	15
919-041074-001	Diode, 1N34A	1
919-041075-001	Diode, 1N4148	1
925-040275-005	Resistor, 200K Ohm, Carbon Trim Pot	1
945-040209-004	Capacitor, Electrolytic, 470uf, 16V	1
946-040226-104	Capacitor, Axial, Polyester, 0.1uf	1
946-040226-105	Capacitor, Axial, Polyester, 1uf	1
946-040229-102	Capacitor, Box, Polyester, 0.001uf	2

RELIABILITY AND PERFORMANCE KIT (Continued)

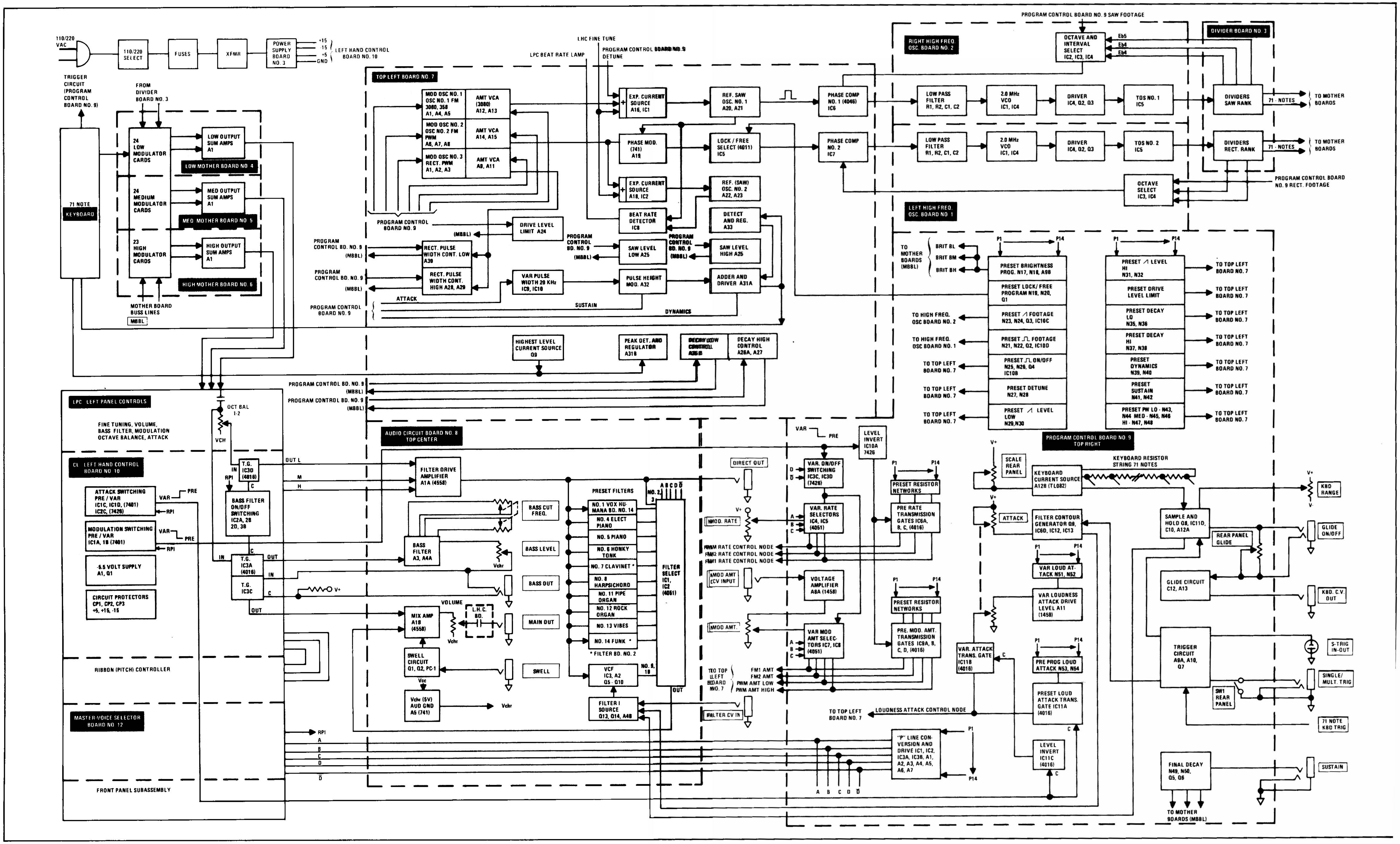
PART NO. 997-043993-001

PART NO.	DESCRIPTION	QTY
946-040229-333	Capacitor, Box, Polyester, 0.033uf	1
946-040229-393	Capacitor, Box, Polyester, 0.39uf	1
946-040229-474	Capacitor, Box, Polyester, 0.47uf	1
946-040231-001	Capacitor, Tantalum, 1.5uf	2
946-040231-003	Capacitor, Tantalum. 2.7uf	1
946-042021-511	Capacitor, Polystyrene, 510pf	2
947-040200-103	Capacitor, Disc, 0.01uf	5
947-042020-102	Capacitor, Disc, 0.001uf	1
947-042020-501	Capacitor, Disc, 500uf	4
965-040771-200	Tubing, 20 AWG, Clear Teflon	1 Ft.
965-040772-004	Tubing, Black, Shrink, 1/8 in., O.D.	2 In.
980-040648-003	Shield	1
987-040751-555	Wire, 24 AWG, Green Bonded	3 In.
987-042266-001	Wire, 2-1/2 in., AWG, Buss	6
991-041052-001	Transistor, 2N3906	1
991-041089-004	Integrated Circuit, Custom 3080 DIP	1
991-042597-001	Integrated Circuit, 4066 BE	1
991-042663-001	Transistor, TIP41	4
991-042908-001	Integrated Circuit, LF353	1
994-040754-776	Cable Assembly, 1 Pin	1
994-041965-940	Ground Wire Assembly	3
994-042811-001	Ground Wire Assembly	1
994-043878-001	Cable, Shielded, Polymoog Keyboard	1
997-043216-001	Stop Bar Assembly	1


110/220 VAC
110/220 SW
FUSES
XFMR
POWER SUPPLY BOARD
+15, -15 +5, GNDS
CL
(71 OSCILLATOR SIGNALS)
LPC-BEAT RATE LAMP
CL (FINE TUNE)
CL (1/4 RANK TUNE)
CL LOCK/FREE
CR (S2EL)
CR (S2EH)
CR PRE RESONATORS
LHC (SAW FOOTAGE)
OCTAVE SELECT
RIGHT HIGH FREQ OSC. BOARD
LEFT HIGH FREQ OSC. BOARD
DIVIDER BOARD
MOD OSC #1 OSC #1 FM 3080/558 A1 A4 A5
AMT VCA 3080 A10 A12 A13
MOS OSC #2 OSC #2 FM/PM A6 A7 A8
A6 A14 A15
MOD OSC #3 RECT PWM A1 A2 A3
A9 A10 A11
EXP CURRENT SOURCE IC1
REF. OSC. #1 A16 SAW RANK
PHASE COMP 4046 A21
PHASE MOD 741 A19
LOCK/FREE SELECT 4011 IC5
PHASE COMP #2 4046 A23
EXP CURRENT SOURCE IC2
REF OSC #2 A18 RECT. RANK
BEAT RATE DETECTOR IC8
DETECT. & REG. A31 B
LOW PASS FILTER
2.0 MHZ VCO IC1, IC4
DRIVER IC4, Q2, Q3
TOS #1 IC5
TOS #2 IC5
DIVIDERS SAW RANK
DIVIDERS ~~SAW RANK~~ RECTANGULAR
CL (RECT. FOOTAGE)
OCTAVE SELECT
MBL
LOW MODS
LOW OUTPUT SUM AMPS A1
LOW MOTHER BD
MBM
MED MODS
MED. OUTPUT SUM AMPS A1
MED MOTHER BD
MBH
HIGH MODS
HIGH OUTPUT SUM AMPS A1
HIGH MOTHER BD
KEYBOARD
KEYBOARD DRIVE LINES
MOTHER BOARD BUSS LINES MBBL
CL
CL MBBL
CL MBBL
RECT PULSE WIDTH CON LOW A30
RECT PULSE WIDTH CON HIGH A28
CR DRIVE LEVEL LIMIT A24
CR SAW LEVEL LOW A25A
CR SAW LEVEL HIGH A25B
MBBL
VAR PULSE WIDTH 20 KHZ OSC IC9 IC10
PULSE HEIGHT MOD A32A
ADDER & DRIVER A31 A33
SUSTAIN
DYNAMICS
HIGHEST LEVEL CURRENT SOURCE Q10 Q11
PEAK DET & REGULATOR A32 B
DECAY LOW CONTROL A26 B
DECAY HIGH CONTROL A26A
TOP LEFT BOARD
CR CR CR
RES & MODE HIGH SW IC1-G1
MED SW IC1-G2
LOW SW IC1-G3
SUM AMPS A2B A2A A3A
DIRECT SUM DRIVE AMP A1A
LPC (DIR. GAIN)
DRIVE AMP A3B
TOP CENTER BOARD
FIXED RESONATOR BALANCE RESISTORS
PRESET GAIN SELECT 4051 IC2
GAIN REC AMP A4
GAIN REC AMP A1B
MASTER PRESET FIXED FILTERS (8)
PRESET FILTER SELECT IC3
LP BP HP
VAR RES MODE SELECT IC4
LOW RES A5, A6A
MED RES A7, A6B
HIGH RES A8, A9A
CR VAR RES MODE SELECT
CR Q & CF CONT.
CR (VAR RES GAIN WIPERS)
LPC (RESONATOR GAIN DRIVE)
CR (VAR RES GAIN DRIVES-3)
LPC (MODE GAIN DRIVE)
LEFT PANEL CONTROLS: FINE TUNING, GAIN, SHAPE ASSIGN & FOOTAGE, TUNING, FM/PM, RECT SHAPE & MOD, SAW LEVEL OCTAVE BALANCE
LPC
OUT L OUT M OUT H
LEFT HAND CONTROL BOARD MODE AND VAR/PRE SWITCHING
BOARD 10
CL
RIBBON (PITCH) CONTROLLER
MODE SELECTOR PANEL
BOARD 12
RIGHT PANEL CONTROLS: KEY BD. RESPONSE, BRIGHT, RESONATORS, VCF
RIGHT HAND CONTROL BD. MODE & VAR/PRE SWITCHING, MASTER PRESET LOGIC, VCH (+4.9) & -5.5 SUPPLY.
BOARD 11
CR
FRONT PANEL ASSEMBLY
CR
SPB
RHC (DECAY LOW)
VBBL
RHC (DECAY HIGH)
MBBL
RHC (SPB)
VCF GAIN SELECT 4051 VCF GAIN SET R'S IC13
VCF LADDER IC15, Q14 Q18-23
GAIN REC AMP & REMOTE GAIN CON. A19
EMPHASIS VCA A22
OUTH OUTM OUTL
LOW/HIGH/ALL SELECT IC12
GAIN REC AMP A18A
DRIVE AMP A20A
TRIG. SELECT IC7, IC8 LOW/HIGH
MONO KB CURRENT SOURCE A14, IC10
RHC (VCF VAR/PRE)
RHC (VCF LOW/HIGH)
LPC (VCF GAIN)
RHC (FIL. EMP.)
LPC (DIR. WIPER)
LPC (RES GAIN WIPER)
TRIG. AMP A5A
TRIG. DET DC A5B
CONTOUR GEN IC5, A10, A11 A12, Q3, Q4
TOP RIGHT BOARD
BUSS
KB S&H IC11, A15
TRIG. DET AC A4B
CONT. AMT VCA A13
GLIDE AMT A16, Q9
SINGLE/MULT/ EXT. TRIG LOGIC IC8, IC9
MOD. OSC. #5 FIL MOD A1, A2, A3B
S&H A7, Q7
NOISE SOURCE IC4
LHC (GLIDE)
DRIVER & OUTPUT ISOLATE A17A, IC11
KB AMT VCA A21
MOD AMT VCA A9
S&H AMT VCA A8
FILTER CURRENT SOURCE Q11, Q12
SUM & DRIVE AMP A20B
SWELL CONTROL CIRCUIT Q15, Q16, AC1
DIRECT OUT
VCF OUT
RES OUT
AUX INPUT
MODE OUT
SWELL INPUT
MIX OUTPUT
LPC (MODE GAIN WIPER)
CR (ATTACK)
CR (SUSTAIN)
CR (DECAY)
CR (CONT. AMT)
CR (MOD RATE)
CR (MOD AMT)
CR (S&H AMT)
CR (CUTOFF)
EXT. SINGLE/MULTI TRIG.
EXT KB OUT
EXT S TRIG.
EXT. KB ON/OFF
EXT. VCF CUTOFF
EXT. FILTER CUTOFF

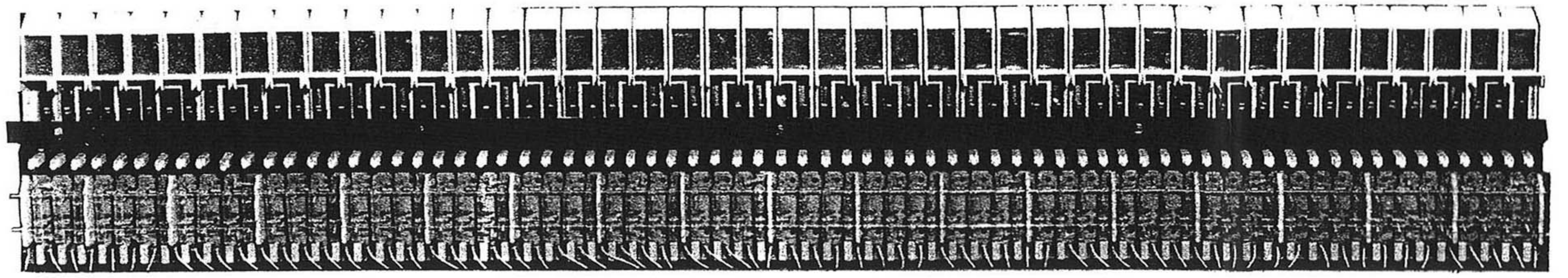
POLYMOOG SYNTHESIZER SYSTEM BLOCK DIAGRAM

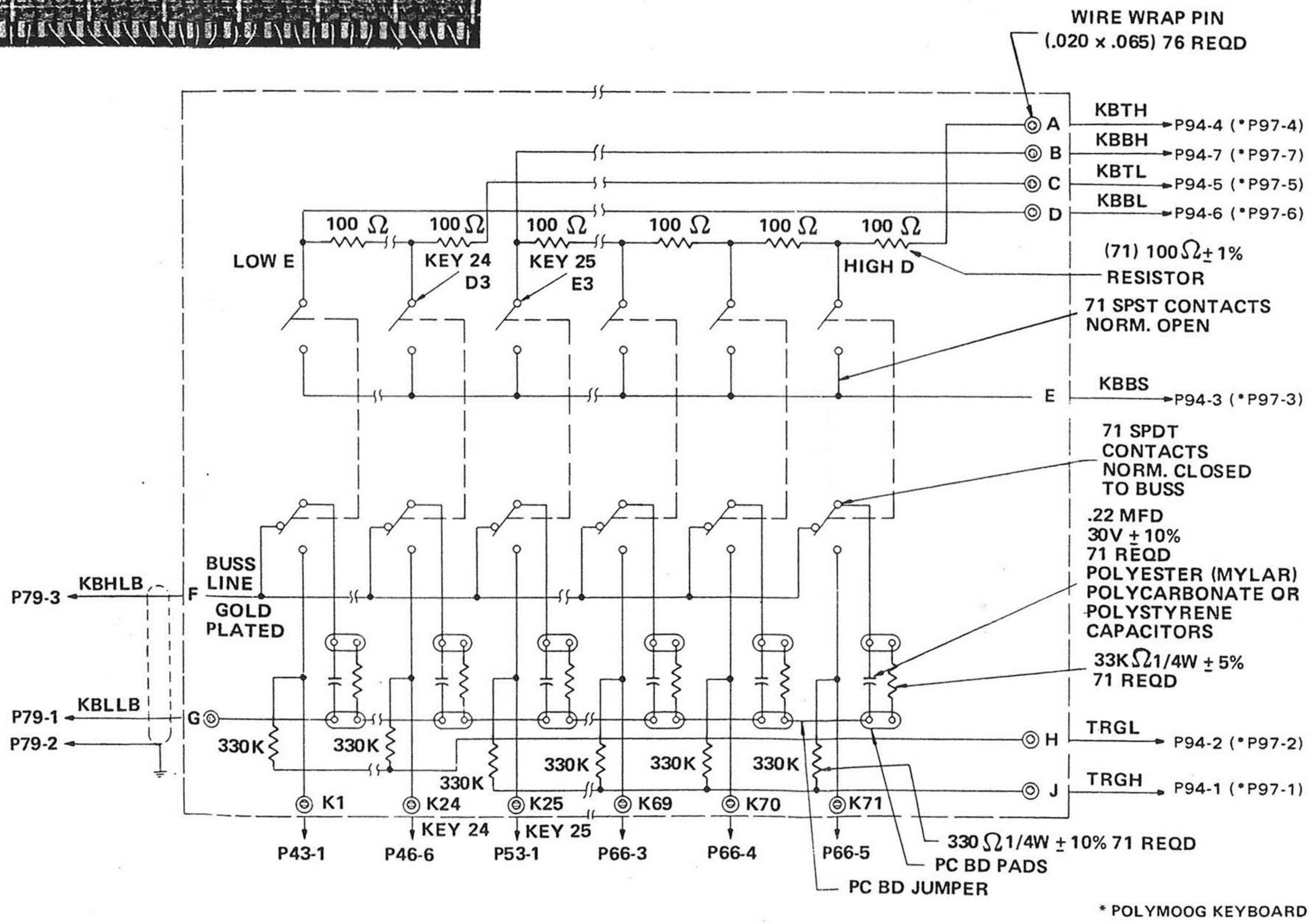
1 2 3 4 5 9
6 7 8 9 •


110/220 VAC
110/220 SELECT
FUSES
XFMR
POWER SUPPLY BOARD NO. 3
+15 -15 +5 GND
LEFT HAND CONTROL BOARD NO. 10
TRIGGER CIRCUIT (PROGRAM CONTROL BOARD NO. 9)
FROM DIVIDER BOARD NO. 3
71 NOTE KEYBOARD
24 LOW MODULATOR CARDS
LOW OUTPUT SUM AMPS A1
LOW MOTHER BOARD NO 4
24 MEDIUM MODULATOR CARDS
MED OUTPUT SUM AMPS A1
MED MOTHER BOARD NO 5
23 HIGH MODULATOR CARDS
HIGH OUTPUT SUM AMPS A1
HIGH MOTHER BOARD NO 6
MOTHER BOARD BUSS LINES (MBBL)
LHC FINE TUNE
LPC BEAT RATE LAMP
PROGRAM CONTROL BOARD NO. 9 DETUNE
TOP LEFT BOARD NO. 7
MOD OSC NO. 1 OSC NO. 1 FM 3080, 358 A1, A4, A5
AMT VCA (3080) A12, A13
MOD OSC NO. 2 OSC NO. 2 FM PWM A6, A7, A8
AMT VCA A14, A15
MOD OSC NO. 3 RECT. PWM A1, A2, A3
AMT VCA A8, A11
EXP. CURRENT SOURCE A16, IC1
PHASE MOD. (741) A19
EXP. CURRENT SOURCE A18, IC2
BEAT RATE DETECTOR IC8
REF. SAW OSC. NO. 1 A20, A21
LOCK / FREE SELECT (4011) IC5
REF. (SAW) OSC. NO. 2 A22, A23
DETECT AND REG. A33
SAW LEVEL LOW A25
SAW LEVEL HIGH A25
PULSE HEIGHT MOD. A32
ADDER AND DRIVER A31A
PROGRAM CONTROL BOARD NO. 9
DRIVE LEVEL LIMIT A24
RECT. PULSE WIDTH CONT. LOW A30
RECT. PULSE WIDTH CONT. HIGH A28, A29
VAR PULSE WIDTH 20 KHz IC9, IC10
ATTACK
SUSTAIN
DYNAMICS
HIGHEST LEVEL CURRENT SOURCE Q9
PEAK DET. AND REGULATOR A31B
DECAY LOW CONTROL A26B
DECAY HIGH CONTROL A26A, A27
PROGRAM CONTROL BOARD NO. 9 SAW FOOTAGE
RIGHT HIGH FREQ OSC. BOARD NO. 2
OCTAVE AND INTERVAL SELECT IC2, IC3, IC4
Eb5 Eb4 Eb4
DIVIDER BOARD NO. 3
PHASE COMP NO. 1 (4046) IC6
PHASE COMP NO. 2 IC7
LOW PASS FILTER R1, R2, C1, C2
2.0 MHz VCO IC1, IC4
DRIVER IC4, Q2, Q3
TOS NO. 1 IC5
TOS NO. 2 IC5
DIVIDERS SAW RANK
DIVIDERS RECT. RANK
71 - NOTES
TO MOTHER BOARDS
OCTAVE SELECT IC3, IC4
PROGRAM CONTROL BOARD NO. 9 RECT. FOOTAGE
LEFT HIGH FREQ. OSC. BOARD NO. 1
TO MOTHER BOARDS (MBBL)
BRIT 8L
BRIT 8M
BRIT 8H
P1 P14
PRESET BRIGHTNESS PROG. N17, N18, A98
PRESET LOCK/ FREE PROGRAM N19, N20, Q1
PRESET ⩘ FOOTAGE N23, N24, Q3, IC10C
PRESET ⎍ FOOTAGE N21, N22, Q2, IC10D
PRESET ⎍ ON/OFF N25, N26, Q4 IC10B
PRESET DETUNE N27, N28
PRESET ⩘ LEVEL LOW N29,N30
PRESET ⩘ LEVEL HI N31, N32
PRESET DRIVE LEVEL LIMIT
PRESET DECAY LO N35, N36
PRESET DECAY HI N37, N38
PRESET DYNAMICS N39, N40
PRESET SUSTAIN N41, N42
PRESET PW LO - N43, N44 MED - N45, N46 HI - N47, N48
TO HIGH FREQ. OSC BOARD NO. 2
TO HIGH FREQ. OSC BOARD NO. 1
TO TOP LEFT BOARD NO. 7
PROGRAM CONTROL BOARD NO. 9 TOP RIGHT
LPC LEFT PANEL CONTROLS
FINE TUNING, VOLUME, BASS FILTER, MODULATION OCTAVE BALANCE, ATTACK
OCT BAL 1-2
VCH
CL LEFT HAND CONTROL BOARD NO. 10
ATTACK SWITCHING PRE / VAR IC1C, IC1D, (7401) IC2C, (7426)
MODULATION SWITCHING PRE / VAR IC1A, 1B (7401)
VAR PRE RPI
-5.5 VOLT SUPPLY A1, Q1
CIRCUIT PROTECTORS CP1, CP2, CP3 +5, +15, -15
T.G. IC3D (4016)
BASS FILTER ON/OFF SWITCHING IC2A, 2B 2D, 3B
T.G. IC3A (4016)
T.G. IC3C
IN OUT
RIBBON (PITCH) CONTROLLER
MASTER-VOICE SELECTOR BOARD NO. 12
FRONT PANEL SUBASSEMBLY
RPI A B C D D̄
AUDIO CIRCUIT BOARD NO. 8 TOP CENTER
OUT L M H
FILTER DRIVE AMPLIFIER A1A (4558)
BASS FILTER A3, A4A
BASS CUT FREQ.
BASS LEVEL
BASS OUT
MIX AMP A1B (4558)
VOLUME
L.H.C. BD.
MAIN OUT
SWELL CIRCUIT Q1, Q2, PC-1
SWELL
Vcc
Vchr (5V) AUD GND A5 (741)
Vchr
PRESET FILTERS
NO. 1 VOX HUMANA BD. NO. 14
NO. 4 ELECT PIANO
NO. 5 PIANO
NO. 6 HONKY TONK
NO. 7 CLAVINET *
NO. 8 HARPSICHORD
NO. 11 PIPE ORGAN
NO. 12 ROCK ORGAN
NO. 13 VIBES
NO. 14 FUNK *
* FILTER BD. NO. 2
NO. 9, 10
VCF IC3, A2 Q5 - Q10
FILTER I SOURCE Q13, Q14, A48
FILTER SELECT IC1, IC2 (4051)
A B C D D̄
NO. 2 3
OUT
DIRECT OUT
MOD. RATE
PWM RATE CONTROL NODE
FM2 RATE CONTROL NODE
FM1 RATE CONTROL NODE
MOD AMT (CV INPUT)
MOD AMT.
TO TOP LEFT BOARD NO. 7
FM1 AMT FM2 AMT PWM AMT LOW PWM AMT HIGH
FILTER CV IN
VAR PRE
VAR. ON/OFF SWITCHING IC3C, IC3D (7426)
VAR. RATE SELECTORS IC4, IC5 (4051)
VOLTAGE AMPLIFIER A8A (1458)
VAR MOD AMT SELECTORS IC7, IC8 (4051)
LEVEL INVERT IC10A 7426
PRESET RESISTOR NETWORKS
PRE RATE TRANSMISSION GATES IC6A, B, C, (4016)
PRE. MOD. AMT. TRANSMISSION GATES IC9A, B, C, D, (4016)
TO TOP LEFT BOARD NO. 7
LOUDNESS ATTACK CONTROL NODE
"P" LINE CONVERSION AND DRIVE IC1, IC2, IC3A, IC3B, A1, A2, A3, A4, A5, A6, A7
A B C D D̄
VAR. ATTACK TRANS. GATE IC11B (4016)
SCALE REAR PANEL
KEYBOARD CURRENT SOURCE A12B (TL082)
KEYBOARD RESISTOR STRING 71 NOTES
ATTACK
FILTER CONTOUR GENERATOR Q8, IC6D, IC12, IC13
VAR LOUD ATTACK N51, N52
VAR LOUDNESS ATTACK DRIVE LEVEL A11 (1458)
PRE PROG LOUD ATTACK N53, N54
PRESET LOUD ATTACK TRANS. GATE IC11A (4016)
LEVEL INVERT IC11C (4016)
SAMPLE AND HOLD Q8, IC11D, C10, A12A
REAR PANEL GLIDE
GLIDE CIRCUIT C12, A13
TRIGGER CIRCUIT A9A, A10, Q7
SW1 REAR PANEL
FINAL DECAY N49, N50, Q5, Q6
TO MOTHER BOARDS (MBBL)
KBD RANGE
GLIDE ON/OFF
KBD. C.V. OUT
S-TRIG IN-OUT
SINGLE/ MULT. TRIG
71 NOTE KBD TRIG
SUSTAIN
V+ V-

POLYMOOG KEYBOARD BLOCK DIAGRAM

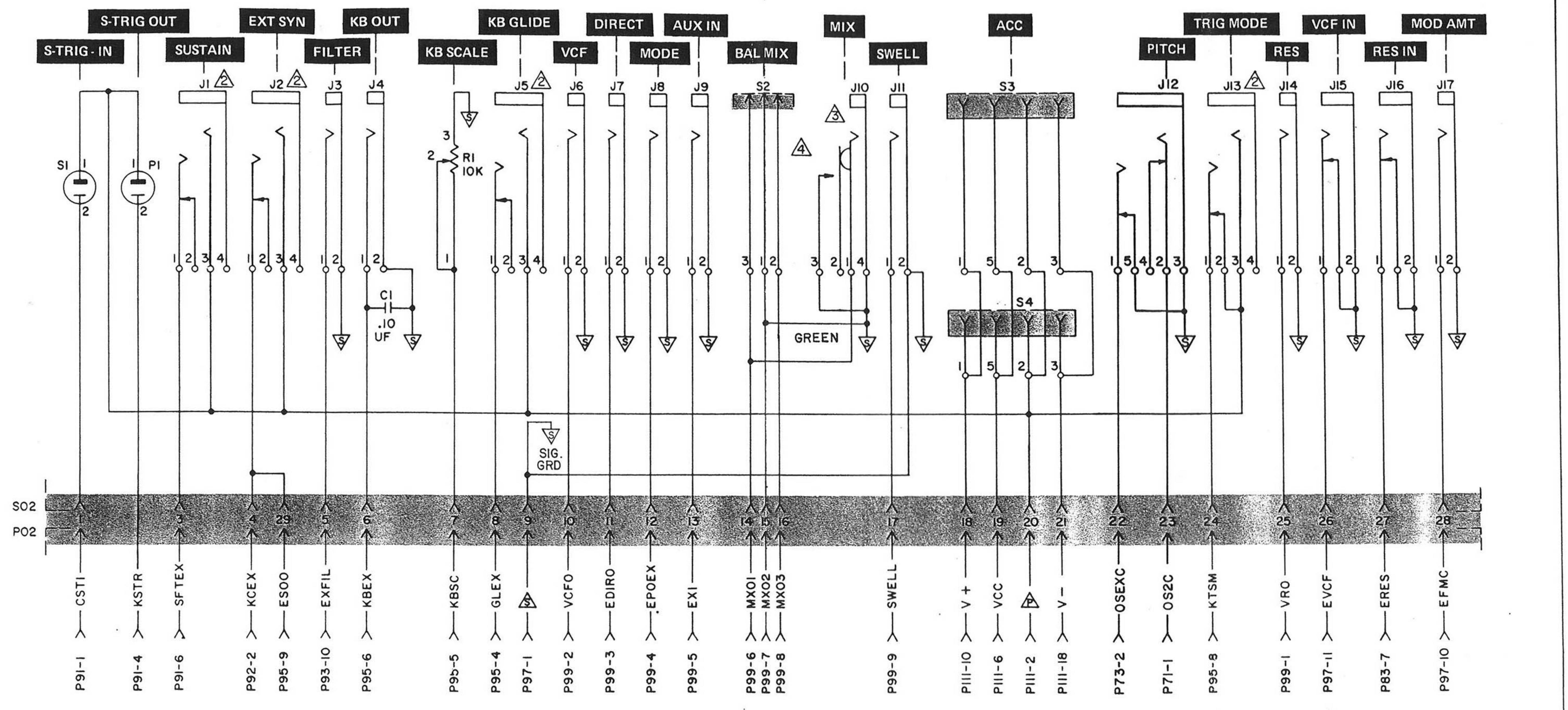
1 2 3 4 5 6 7 14
8 9 10 11 12 13 14

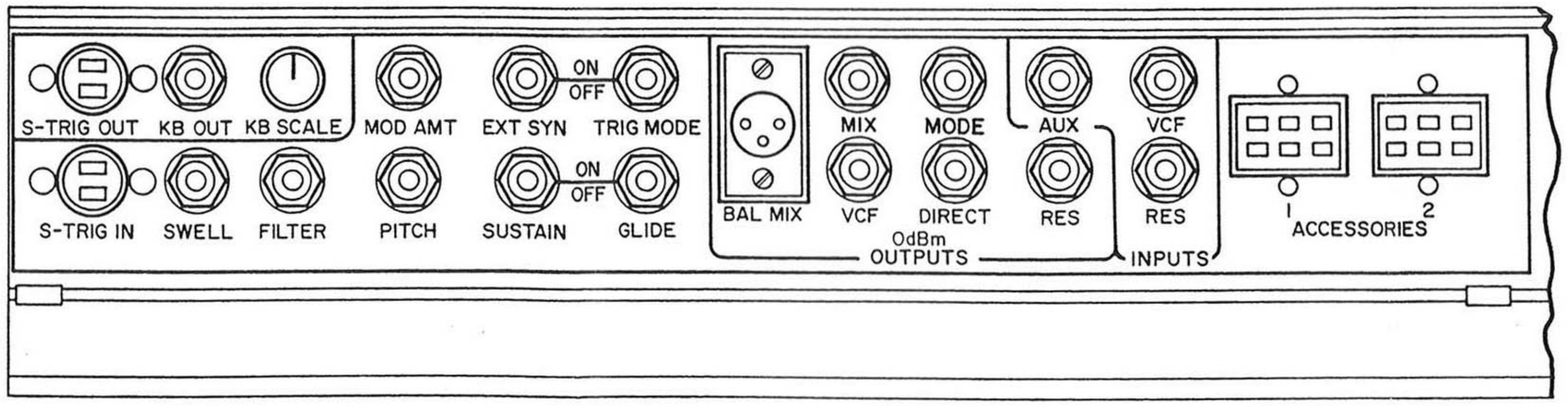



WIRE WRAP PIN
(.020 x .065) 76 REQD
A
B
C
D
KBTH
P94-4 (*P97-4)
KBBH
P94-7 (*P97-7)
KBTL
P94-5 (*P97-5)
KBBL
P94-6 (*P97-6)
100 Ω
100 Ω
100 Ω
100 Ω
100 Ω
100 Ω
LOW E
KEY 24
D3
KEY 25
E3
HIGH D
(71) 100Ω ± 1%
RESISTOR
71 SPST CONTACTS
NORM. OPEN
E
KBBS
P94-3 (*P97-3)
71 SPDT
CONTACTS
NORM. CLOSED
TO BUSS
.22 MFD
30V ± 10%
71 REQD
POLYESTER (MYLAR)
POLYCARBONATE OR
POLYSTYRENE
CAPACITORS
33KΩ 1/4W ± 5%
71 REQD
BUSS
LINE
GOLD
PLATED
KBHLB
P79-3
F
KBLLB
P79-1
P79-2
G
H
TRGL
P94-2 (*P97-2)
J
TRGH
P94-1 (*P97-1)
330K
330K
330K
330K
330K
330K
K1
K24
K25
K69
K70
K71
KEY 24
KEY 25
P43-1
P46-6
P53-1
P66-3
P66-4
P66-5
330 Ω 1/4W ± 10% 71 REQD
PC BD PADS
PC BD JUMPER
* POLYMOOG KEYBOARD

REV	DESCRIPTION	EO
A	KB WAS F TO E, RES. PACK WAS 1K, ADDED (72) 1 MEG RES., 33K RES. WAS 22K, POINTS A, B, C, E, H AND J RELOCATED TO HIGH END. (REDRAWN)	
B	RELOCATED KEY SPLIT: KEY 24 WAS 29, KEY 25 WAS 30. 100 Ω RES. PACK WAS 7 REQ'D, 2 PACKS LOW END WAS 3 PACKS.	
C	330K RES. WAS 1 MEG., RES. AND CAP. WERE 72 REQ'D, KB. WAS C-B	
-	RELEASED FOR PRODUCTION	0215
D	ADDED PLUG AND FUNCTION DESIGNATION REMOVED NOTE 4 AND RESISTOR PACKS	0390
E	CONTACT SWITCHING SPEC. REVISED	1082

GENERAL KEYBOARD CIRCUIT SCHEMATIC DIAGRAM


S-TRIG - IN
S-TRIG OUT
SUSTAIN
EXT SYN
FILTER
KB OUT
KB SCALE
KB GLIDE
VCF
DIRECT
MODE
AUX IN
BAL MIX
MIX
SWELL
ACC
PITCH
TRIG MODE
RES
VCF IN
RES IN
MOD AMT
J1 2
J2 2
J3
J4
J5 2
J6
J7
J8
J9
S2
J10 3
J11
S3
J12
J13 2
J14
J15
J16
J17
S1
P1
R1 10K
C1 .10 UF
4
GREEN
S4
S
SIG. GRD
SO2
PO2
1 3 4 29 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
CSTI
KSTR
SFTEX
KCEX
ESOO
EXFIL
KBEX
KBSC
GLEX
VCFO
EDIRO
EPOEX
EXI
MXO1
MXO2
MXO3
SWELL
V +
VCC
V -
OSEXC
OS2C
KTSM
VRO
EVCF
ERES
EFMC
P91-1
P91-4
P91-6
P92-2
P95-9
P93-10
P95-6
P95-5
P95-4
P97-1
P99-2
P99-3
P99-4
P99-5
P99-6
P99-7
P99-8
P99-9
P111-10
P111-6
P111-2
P111-18
P73-2
P71-1
P95-8
P99-1
P97-11
P83-7
P97-10


S-TRIG OUT
KB OUT
KB SCALE
MOD AMT
EXT SYN
ON
OFF
TRIG MODE
S-TRIG IN
SWELL
FILTER
PITCH
SUSTAIN
GLIDE
BAL MIX
MIX
MODE
VCF
DIRECT
AUX
RES
0dBm
OUTPUTS
INPUTS
1
2
ACCESSORIES

NOTE:
REFER TO THE REPLACEMENT PARTS LIST IN VOLUME 1, SECTION 1 FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.

REV	DESCRIPTION	EO

NOTES:

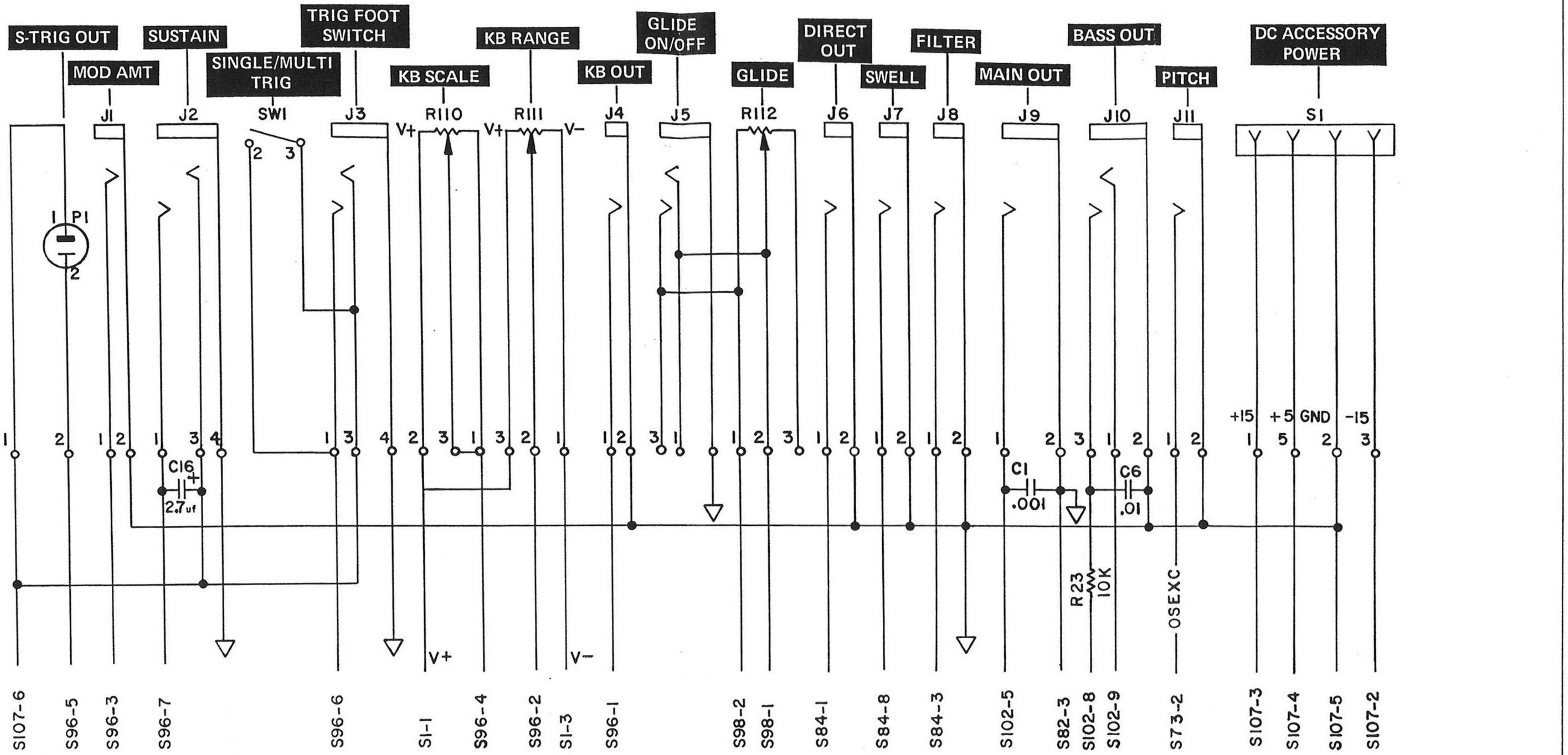
1. ALL JACKS ARE .250 DIA PHONE TYPE EXCEPT AS NOTED.

△2. .206 DIA PHONE JACK.

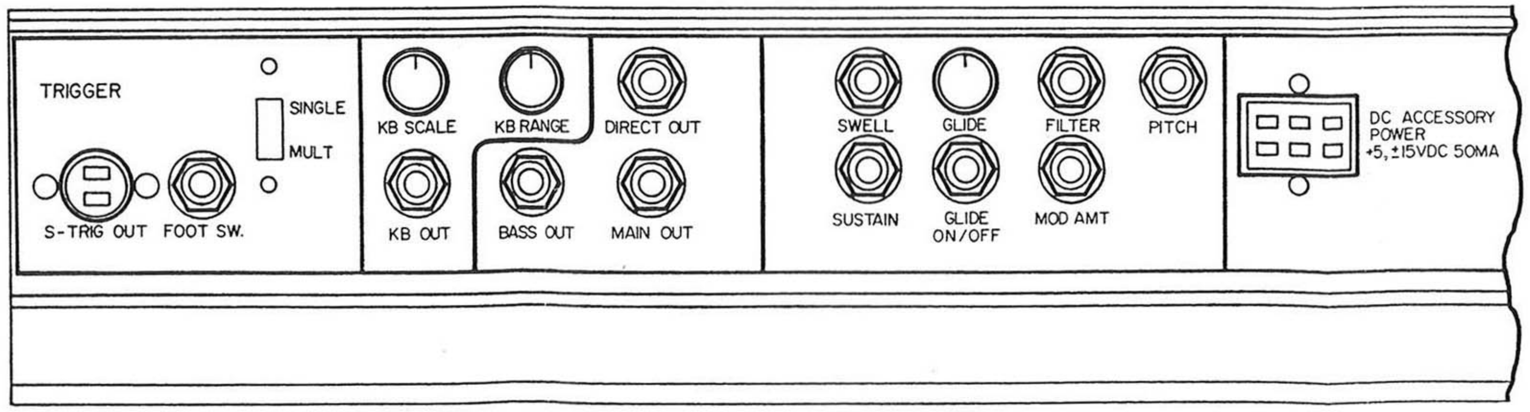
△3. .250 DIA PHONE JACK WITH INSULATED NORM. OPEN SWITCH BETWEEN PINS 2 & 3.

△4. REWIRE ON INSTRUMENTS BELOW SERIAL NO. 3000 FOR SIMULTANEOUS OUTPUTS.

POLYMOOG REAR PANEL CONTROLS SCHEMATIC DIAGRAM


S-TRIG OUT
MOD AMT
SUSTAIN
SINGLE/MULTI TRIG
TRIG FOOT SWITCH
KB SCALE
KB RANGE
KB OUT
GLIDE ON/OFF
GLIDE
DIRECT OUT
SWELL
FILTER
MAIN OUT
BASS OUT
PITCH
DC ACCESSORY POWER
J1
J2
SW1
J3
R110
R111
J4
J5
R112
J6
J7
J8
J9
J10
J11
S1
1 P1 2
V+
V+
V−
C16 2.7uf
C1 .001
C6 .01
R23 10K
OSEXC
+15
+5
GND
-15
S107-6
S96-5
S96-3
S96-7
S96-6
S1-1
S96-4
S96-2
S1-3
S96-1
S98-2
S98-1
S84-1
S84-8
S84-3
S102-5
S82-3
S102-8
S102-9
S73-2
S107-3
S107-4
S107-5
S107-2

NOTE:
REFER TO THE REPLACEMENT PARTS LIST IN VOLUME 1, SECTION 1 FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.


TRIGGER
SINGLE
MULT
S-TRIG OUT
FOOT SW.
KB SCALE
KB RANGE
DIRECT OUT
KB OUT
BASS OUT
MAIN OUT
SWELL
GLIDE
FILTER
PITCH
SUSTAIN
GLIDE ON/OFF
MOD AMT
DC ACCESSORY POWER +5, ±15VDC 50MA

REV	DESCRIPTION	EO

POLYMOOG KEYBOARD REAR PANEL CONTROLS SCHEMATIC DIAGRAM

POLYPEDAL ASSEMBLY
REPLACEMENT PARTS LIST (Refer to Exploded View, Page 9)

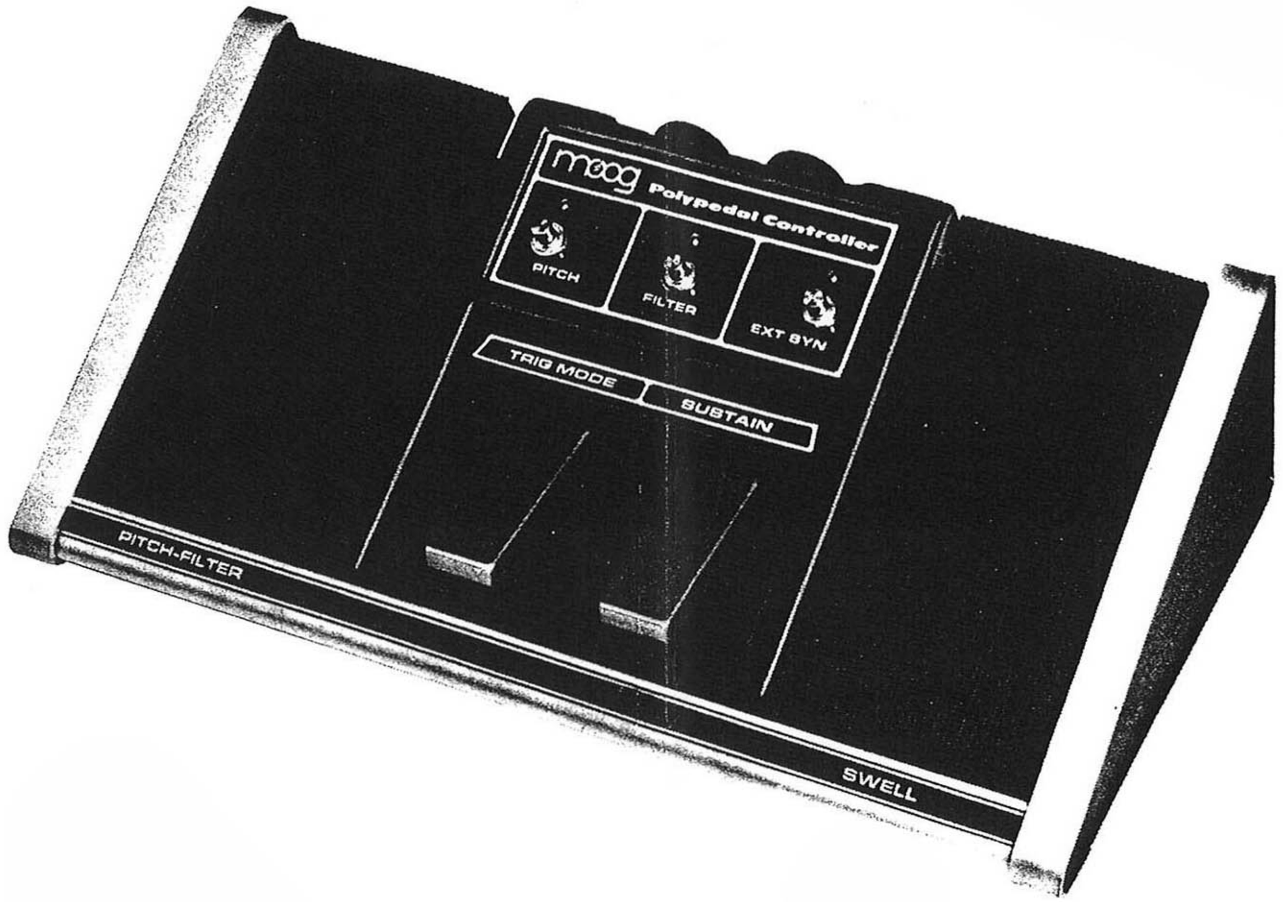
INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
	997-040027-001	Polypedal Model 285A consisting of:	
1	997-040535-002	Panel Assembly, R. H.	1
2	997-040535-001	Panel Assembly, L. H.	1
3	967-040115-001	Panel Bracket	2
4	811-050039-010	Screw, S.T., No. 8 x 5/8 in.	14
5	806-055039-010	Screw, Mach., No. 8-32 x 5/8 in.	4
6	902-040499-002	Nut, Tee, No. 8-32	4
7	904-041395-008	Washer, Lock, No. 8	4
8	916-040842-001	Pad, Foot	4
9	967-040007-001	Extrusion, Front	1
10	811-040039-012	Screw, S.T., No. 6 x 3/4 in.	4
11	902-040500-001	Nut, Speed	15
12	904-041390-030	Washer, Flat, No. 6 x 3/8 in. OD	15
13	978-040012-001	Cover, Rear	1
14	903-040491-032	Screw, S.T., No. 6 x 1 in.	4
15	967-040926-001	Bracket, Angle	4
16	913-040328-001	Moog Logo	1
17	913-040587-002	Label, Model Identification	1
18	978-040011-001	Base	1
19	961-040116-001	Spacer, Pedal	2
20	997-040030-001	Pedal Assembly, SWELL	2
21	959-042034-001	Rubber, Pedal Mat	2
22	937-042045-001	Pedal	2
23	937-042046-001	Base, Pedal	2
24	806-065039-016	Screw, Mach., Pan Hd., No. 10-32 x 1 in.	8
25	904-040494-018	Washer, Lock, No. 10	8
26	904-040948-006	Washer, Cup	12
27	916-042031-001	Channel, Rubber	2
28	916-042032-001	Plug, Bumper, 5/8 in. Dia. x 1/8 in. thick	2
29	925-040649-002	Resistor, Rotary, 10K Ohms, Linear (R6)	2
30	964-040196-001	Rack, 32 Pitch, 14-1/2 Degree	2
31	976-040198-001	Pin, Roll, 1/16 in. Dia. x 1/2 in. Lg.	2
32	964-040195-002	Gear, Pinion, 32 Pitch, 16 Teeth	2
33	976-040197-001	Pin, Roll, 3/32 in. Dia. x 1/2 in. Lg.	2
34	902-040504-007	Nut, 3/8-32	4
35	904-042495-021	Washer, Lock, 3/8 in. Internal Tooth	3
36	964-040218-001	Spool, Nylon, 0.257 in. ID x 1/2 in. OD	2
37	973-040586-406	Spacer, No. 8-1/4 in. Dia. x 7/16 in. Lg., Brass	2
38	973-040217-001	Nut, 8-32 x 3/8 Hex., 7/16 in. Lg.	2
39	806-055339-006	Screw, Mach., Bind. Hd., 8-32 x 3/8 in.	6
40	904-041392-035	Washer, Flat	2
41	967-040008-001	Bracket, Pot	2

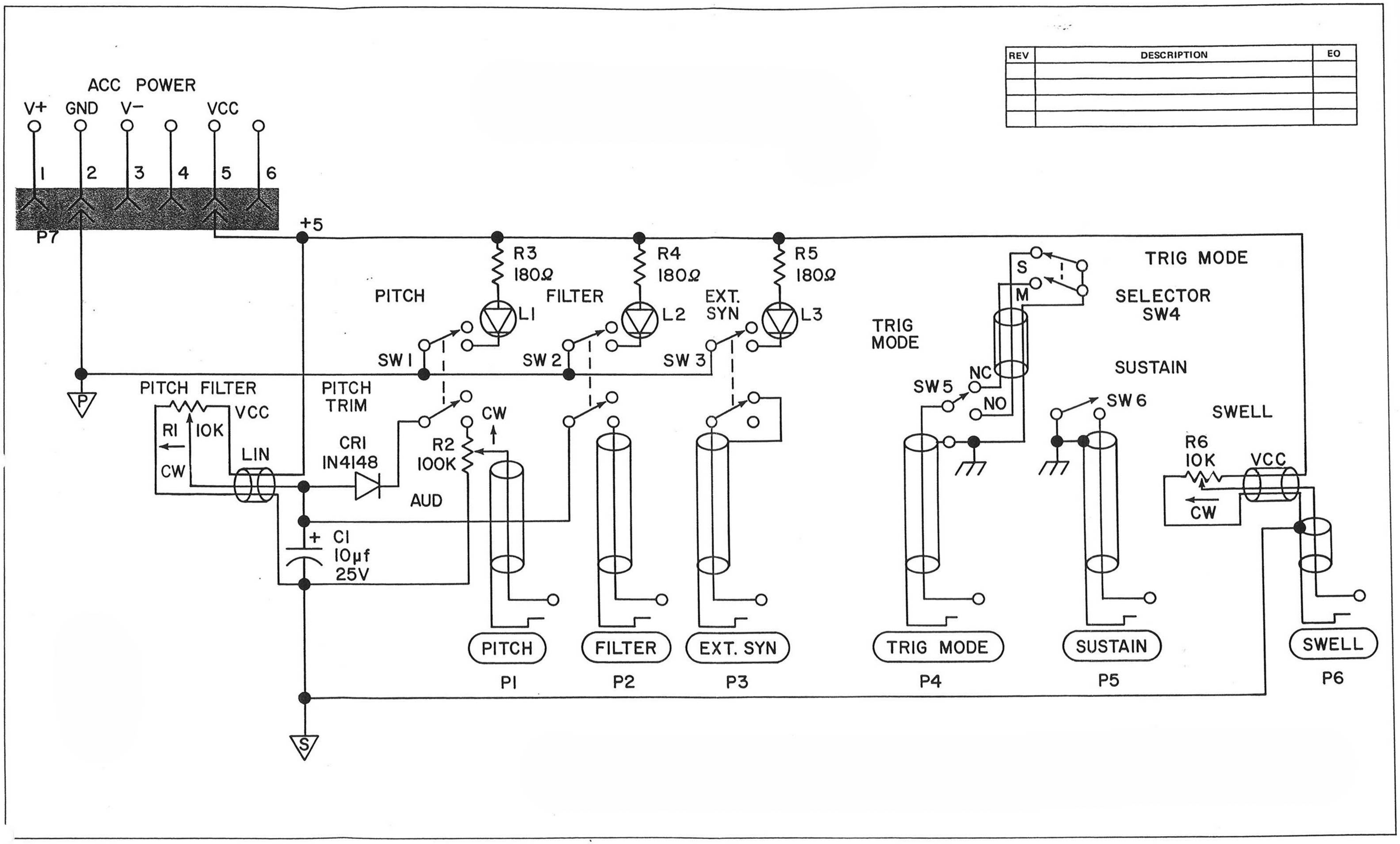
POLYPEDAL ASSEMBLY
REPLACEMENT PARTS LIST (Cont.)

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
42	802-055442-000	Nut, KEPS, 8-32	2
43	975-042039-001	Spring, Compression	2
44	902-042023-001	Nut, 5/16 x 24 (Special).	2
45	963-042036-001	Plate, Friction	2
46	904-042056-001	Washer, Friction	4
47	974-042038-001	Shaft, Pivot	2
48	976-042042-001	Retainer, 1/4 in. Dia.	2
49	978-040481-001	Spacer, Foot Switch	2
50	903-040491-032	Screw, S.T., No. 6 x 1-1/2 in.	4
51	997-040028-001	Switch Assembly, Foot	2
52	967-040002-001	Pedal, Switch	2
53	967-040003-001	Pedal Chassis	2
54	975-040113-001	Spring, Extension	4
55	916-042033-001	Plug, Rubber Bumper, 17/32 in. Dia. x 1/8 in.	2
56	806-045036-016	Screw, Mach., 6-32 x 1 in.	2
57	916-041517-004	Grommet, 3/8 in. O.D.	2
58	973-042037-013	Spacer, 6-1/4 in. Dia. x 1/2 in.	2
59	905-042435-001	Washer, Fiber, 1/2 in. O.D.	2
60	902-040592-002	Nut, Lock, ESNA	2
61	960-040036-001	Switch, TRIG, S.P.D.T. (SW5)	1
62	960-042035-001	Switch, SUSTAIN, S.P.S.T. (SW6)	1
63	806-023112-008	Screw, Mach., 4-40 x 1/2 in.	4
64	811-040039-012	Screw, S.T., No. 6 x 3/4 in.	4
	997-040533-001	Enclosure Assembly, Wired	
	997-040532-001	Enclosure Assembly	
65	978-040010-001	Enclosure	1
66	811-050039-016	Screw, S.T., No. 8 x 1 in.	4
67	916-807209-011	Grommet, 3/8 in. Dia.	2
68	976-040792-008	Clamp, Cable	2
69	811-050039-010	Screw, S.T., No. 6 x 5/8 in.	2
70	913-040468-001	Overlay, Front Panel	1
71	913-040469-001	Labels, SUSTAIN, TRIG MODE	1
72	913-040471-001	Labels, SWELL, PITCH FILTER	1
73	960-040042-001	Switch, Push, D.P.D.T. (SW1, SW2, SW3)	3
74	902-040504-006	Nut, Hex., 15/32-32	6
75	904-040065-005	Washer, Lock, 15/32	3
76	904-041495-006	Washer, Flat, 15/32	3
77	902-041442-007	Nut, Knurled, 15/32-32	3
78	967-040214-001	Bracket, Switch	3
79	852-512181-001	Resistor, Carbon Film, 1/2W, ±5%, 180 Ohm, (R3,R4, R5)	3
80	939-040920-001	Diode, Light Emitting, (L1, L2, L3)	3
81	976-040923-001	Clip, Diode	3

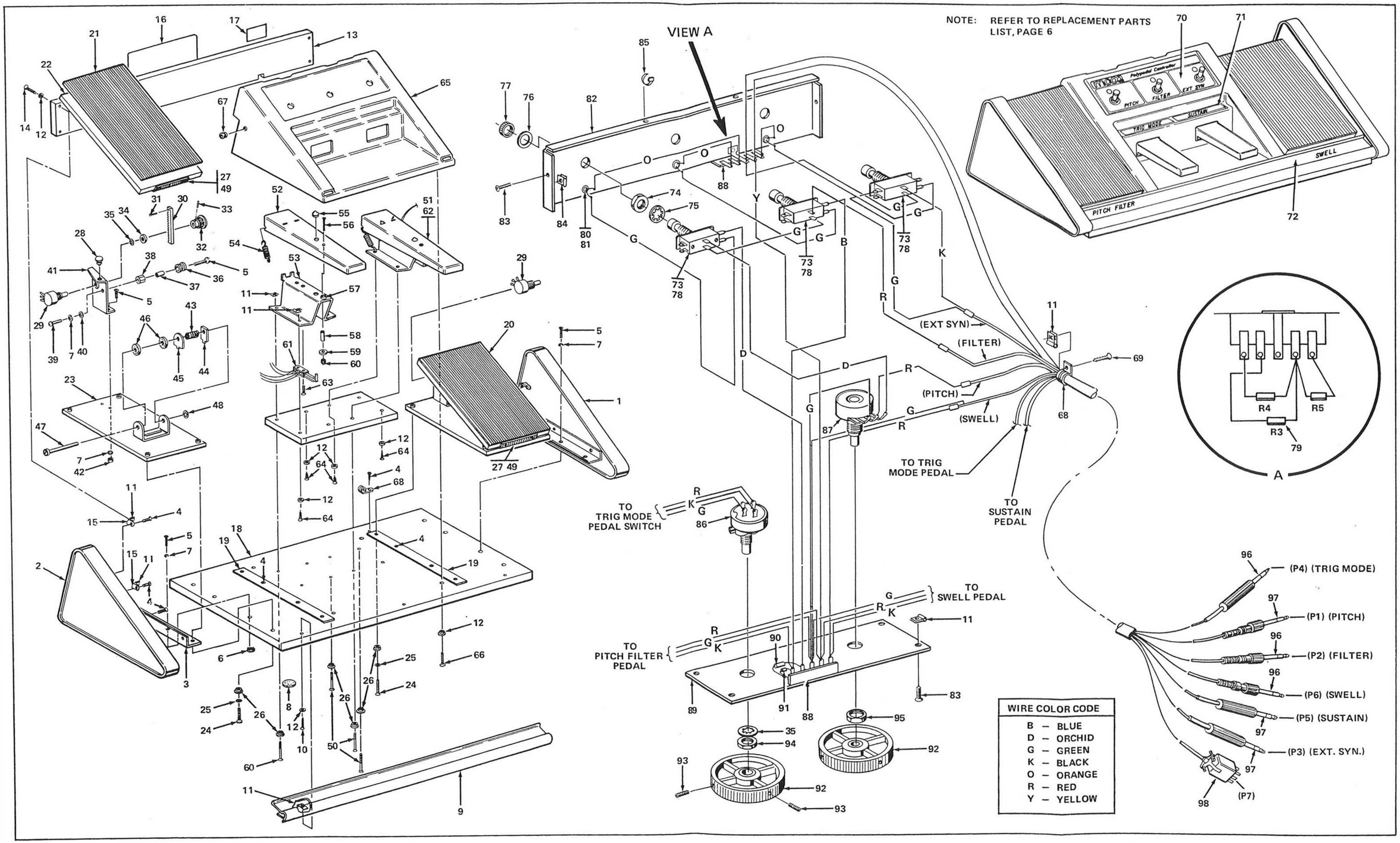
POLYPEDAL ASSEMBLY
REPLACEMENT PARTS LIST (Cont.)

INDEX NO. OR REF DESIG	PART NUMBER	DESCRIPTION	QTY
82	967-040214-001	Panel	1
83	903-041428-024	Screw, S.T., No. 6 x 3/8 in.	6
84	902-040500-001	Nut, Speed	2
85	976-040793-001	Tie Wrap	2
86	960-040479-001	Switch, Rotary, S.P.D.T. (SW4)	1
87	925-042022-001	Resistor, Rotary, 100K, AUDIO (R2)	1
88	988-042070-005	Terminal Strip, 5 position	2
89	963-040025-001	Panel, Rear	1
90	945-040209-001	Capacitor, Electrolytic, 10uf, 35V	1
91	919-041075-001	Diode, 1N4148	1
92	915-040480-001	Knob, 1-7/8 in. Dia.	2
93		Setscrew, (Furnished with Knobs)	4
94	902-040504-007	Nut, 3/8 x 32	1
95	964-040717-001	Shaft Lock, Nylon	1
96	957-041795-001	Phone Cable (P1, P2, P6)	3
97	910-042127-001	Plug, Phone, 206D (P3, P4, P5)	3
98	910-041711-006	Plug, 6 Conductor (P7)	1
	932-040639-001	Shipping Carton	2
	932-040644-001	Shipping Bag	2
	932-040817-001	Foam Insert, L.H.	2
	932-040817-002	Foam Insert, R.H.	2

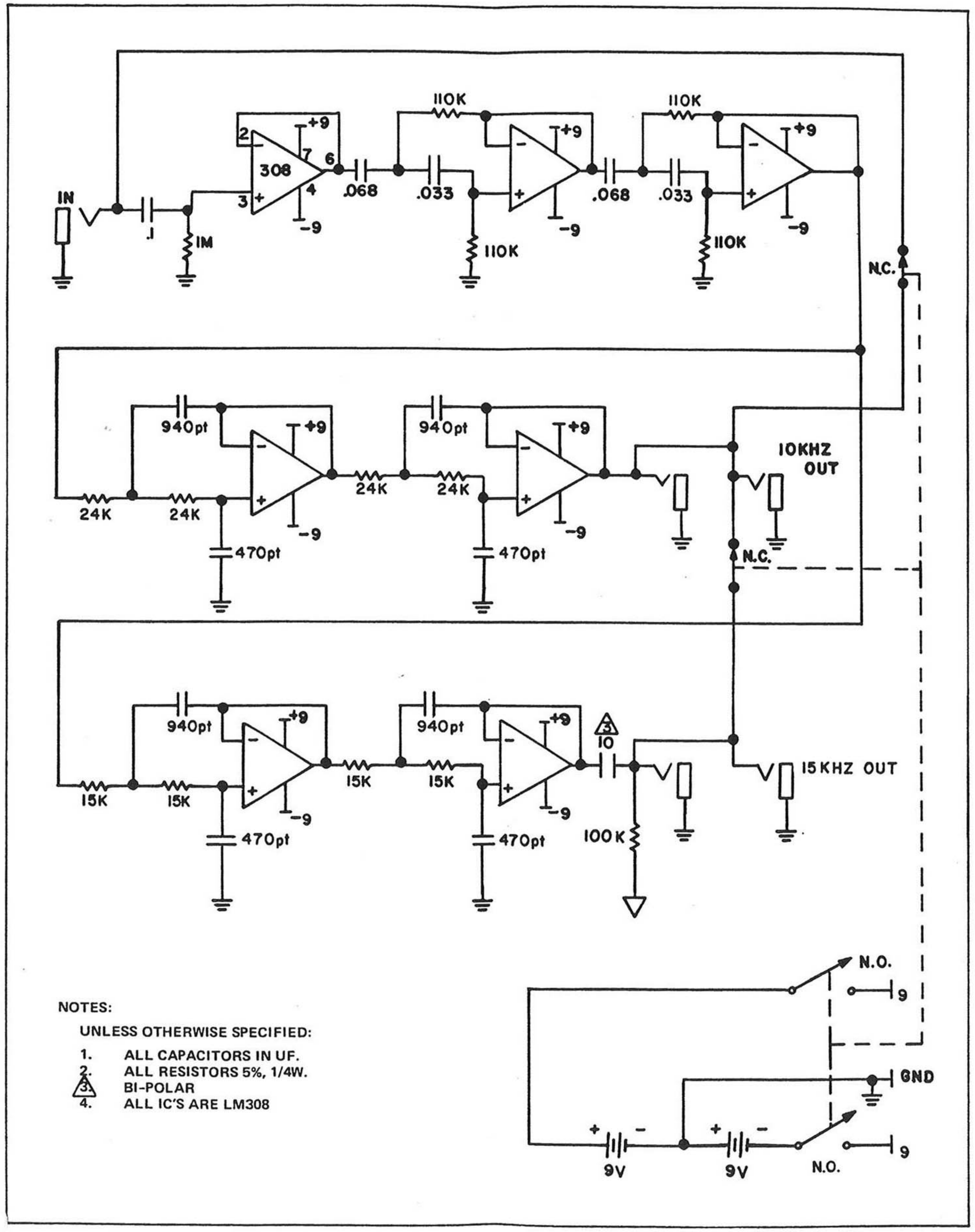



REV
DESCRIPTION
EO
ACC POWER
V+
GND
V−
VCC
1
2
3
4
5
6
P7
+5
P
S
R3
180Ω
R4
180Ω
R5
180Ω
PITCH
FILTER
EXT. SYN
L1
L2
L3
SW 1
SW 2
SW 3
PITCH FILTER
VCC
RI
10K
CW
LIN
PITCH TRIM
CRI
IN4148
R2
100K
CW
AUD
CI
10µf
25V
TRIG MODE
S
M
TRIG MODE SELECTOR SW4
SW 5
NC
NO
SUSTAIN
SW 6
SWELL
R6
10K
VCC
CW
PITCH
FILTER
EXT. SYN
TRIG MODE
SUSTAIN
SWELL
P1
P2
P3
P4
P5
P6

POLYPEDAL SCHEMATIC DIAGRAM


NOTE: REFER TO REPLACEMENT PARTS LIST, PAGE 6
VIEW A
A
moog
Polypedal Controller
PITCH
FILTER
EXT SYN
TRIG MODE
SUSTAIN
PITCH FILTER
SWELL
(EXT SYN)
(FILTER)
(PITCH)
(SWELL)
TO TRIG MODE PEDAL
TO SUSTAIN PEDAL
TO TRIG MODE PEDAL SWITCH
TO SWELL PEDAL
TO PITCH FILTER PEDAL
R4
R5
R3
(P4) (TRIG MODE)
(P1) (PITCH)
(P2) (FILTER)
(P6) (SWELL)
(P5) (SUSTAIN)
(P3) (EXT. SYN.)
(P7)
WIRE COLOR CODE
B – BLUE
D – ORCHID
G – GREEN
K – BLACK
O – ORANGE
R – RED
Y – YELLOW
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98

POLYPEDAL ELECTRICAL/MECHANICAL EXPLODED VIEW



NOTES:

UNLESS OTHERWISE SPECIFIED:

1. ALL CAPACITORS IN UF.
2. ALL RESISTORS 5%, 1/4W.
3. BI-POLAR
4. ALL IC'S ARE LM308

STANDARD NOISE FILTER SCHEMATIC

POLYMOOG NOISE TEST

NOISE

Set up the Polymoog as follows:

Preset 2.	PIANO
Rectangular only.	
MASTER GAIN CONTROLS:	In full down position.
SHAPE, MOD, VAR:	SHAPES in full up position, RATES and AMT in full down position.
LOUDNESS CONTOUR VAR:	All pots in full down position except SUSTAIN in full up position.
RESONATORS:	Low pass – All pots in full down position except place HIGH GAIN in full up.

Check for maximum output level from DIRECT, MODE and VCF of +4 ± 2dBm each when depressing A4 and +8 ± 2dBm from resonators. Then make the following noise checks in each preset. The MASTER GAIN Control for the output under test should be full up, all other MASTER GAIN Controls full down. The noise is specified as a maximum voltage level on the Hewlett Packard Model 400F voltmeter (or equivalent). Check level at unbalanced MIX Out and individual output under test.

PRESET NOISE CHECKS			MIX OUTPUT	INDIVIDUAL OUTPUT
1. STRING	(a)	MODE	-82	-80
	(b)	DIRECT	-81	-78
	(c)	VCF	-74	-72
2. PIANO	(a)	MODE	-72	-78
	(b)	DIRECT	-82	-80
	(c)	VCF - hit top key	-74	-73
3. ORGAN	(a)	MODE	-77	-75
	(b)	DIRECT	-81	-78
	(c)	VCF	-74	-74
4. HARPSICHORD				
	(a)	MODE	-80	-81
	(b)	DIRECT	-72	-73
	(c)	VCF	-75	-74
5. FUNK	(a)	MODE	-70	-68
	(b)	DIRECT	-79	-80
	(c)	VCF - splits on S and H	-72	-73
6. CLAVINET	(a)	MODE	-71	-70
	(b)	DIRECT	-80	-79
	(c)	VCF	-70	-68

POLYMOOG NOISE TEST (Continued)

PRESET NOISE CHECKS				MIX OUTPUT	INDIVIDUAL OUTPUT
7.	VIBES	(a)	MODE	- 72	- 75
		(b)	DIRECT	- 80	- 79
		(c)	VCF	- 72	- 73
8.	BRASS	(a)	MODE	- 80	- 79
		(b)	DIRECT	- 83	- 82
		(c)	VCF	- 77	- 75

RESONATORS - NOISE CHECKS

1.	All pots down in RES and in MASTER GAIN	- 81
2.	All pots down in RES, lowpass; MASTER GAIN up	- 80
3.	All pots up in RES, lowpass; MASTER GAIN up	- 55
4.	All pots up in RES, highpass; MASTER GAIN up	- 57
5.	All pots centered, MASTER GAIN up, bandpass	- 75

RESIDUAL NOISE CHECK

All pots down - Preset 1 strings

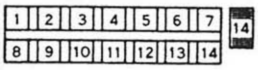
MIX	- 90
VCF	- 84
DIRECT	- 84
MODE	- 84

Also depress a note and check for no residual output with all pots down.

POLYMOOG KEYBOARD NOISE TEST

NOISE: Connect AC voltmeter to the appropriate output and check for the following maximum noise levels (dBm):

PRESET NUMBER	DIRECT	MAIN	BASS
1. VOX HUMANA	-78	-84	-72
2. STRING 1	-82	-81.5	-78
3. STRING 2	-79	-83	-73
4. ELECTRIC PIANO	-83.5	-81	-81
5. PIANO	-83.5	-80	-82
6. HONKY TONK PIANO	-83	-81.5	-79
7. CLAV	-82	-81	-78
8. HARPSICHORD	-78	-83	-73
9. BRASS	-84	-77	-84
10. BRASS CHORUS	-84	-76	-81
11. PIPE ORGAN	-83	-83.5	-78
12. ROCK ORGAN	-79	-83.5	-75
13. VIBES	-82	-78	-79
14. FUNK	-82	-79	-78



POLYMOOG SYNTHESIZER
FINAL TEST AND INSPECTION CHECKLIST

1. MECHANICAL INSPECTION

☐ Remove Any Loose Foreign Material From Unit Interior
☐ Cover, Leg Brackets
☐ Feet and Truss Bar Knobs
☐ Keyboard Mounting Screws
☐ Trim Strips in Place

2. POWER SUPPLIES

☐ +15V ☐ -15V ☐ +5V
☐ +4.85V ☐ -5.5V (All ± 0.010V)

3. MASTER OSCILLATOR TUNING

☐ A440

4. MODE PRESET VOICES

☐ All Voices Correct
☐ Preset 9 Switches
All Functions to Variable
☐ Part/Full Retains All Variable Functions When New Preset is Selected
☐ All Notes Working on All Presets
☐ Noise Levels Acceptable

5. RESONATOR CONTROL SECTION

☐ Slide Controls
☐ Pushbutton Controls
☐ All Voices Correct

6. VCF CONTROL SECTION

☐ Slide Controls
☐ Pushbutton Controls
☐ All Voices Correct

7. DIRECT OUTPUT

☐ ⊿⊿ Sawtooth
☐ FM
☐ 8′ 4′ Combination
☐ RANK MIX (Upper and Lower)
☐ RANK TUNE
☐ OCTAVE BALANCE

7. DIRECT OUTPUT (Continued)

☐ ⊓⊔⊓ Rectangular
☐ 16′ 8′ Combination
☐ FM/PM
☐ Lock

8. SHAPE AND MODULATION CONTROL SECTION

☐ SHAPE – Upper and Lower
☐ MOD Amount – Upper and Lower
☐ RATE – Upper and Lower

9. RIBBON CONTROLLER

☐ Zero Pitch Change Before And After Use
☐ Centering
☐ Oscillator Tracking
☐ Smoothness of Appearance

10. LOUDNESS CONTOUR CONTROL SECTION

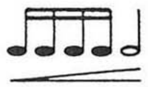
☐ Slide Controls
☐ Final Decay – Each Note

11. MODULATOR CARD LEAKAGE

☐ No Bleedthrough After 30 Seconds

12. KEYBOARD

☐ Feel
☐ ⊿⊿ On Each Key
☐ ⊓⊔⊓ On Each Key
☐ Dynamic Consistency 3dB Between Notes and 6dB Overall
☐ Dynamics Range and Response to Rapidly Repeated Triggering and Decay Uniformity

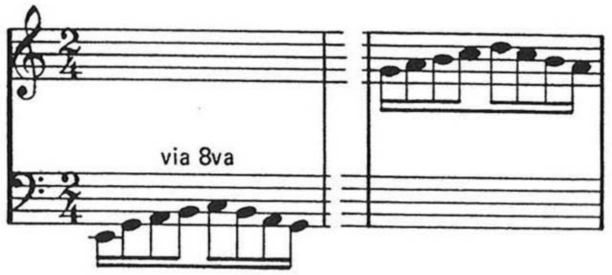


(Checks for Cleanliness, Contact Spacing and Backwrap)

POLYMOOG SYNTHESIZER
FINAL TEST AND INSPECTION CHECKLIST (Continued)

12. KEYBOARD (Continued)

☐ Overall Keyboard Response to Fast Runs



13. REAR PANEL

☐ RESONATOR In, VCF In, and AUX In
☐ S-TRIG In/Out
☐ TRIG MODE
☐ GLIDE ON/OFF
☐ SUSTAIN ON/OFF
☐ EXT SYN ON/OFF
☐ SWELL
☐ MOD AMOUNT
☐ PITCH, External Oscillator
☐ VCF
☐ Keyboard Control Voltage Out

POLYMOOG KEYBOARD
FINAL TEST AND INSPECTION CHECKLIST
(Compare Voicing to Another Polymoog or Tape Cassette)

1. MECHANICAL INSPECTION

☐ Remove any Loose Matter from Unit Interior
☐ Ensure All Boards are Properly Secured
☐ Cover
☐ Truss Bar Knobs (If Available)
☐ Feet
☐ Keyboard Mounting Screws
☐ Trim Strips
☐ Ribbon Smoothness

2. POWER SUPPLIES

☐ +15V ☐ -15V
☐ +5V (All ± 0.010V)

3. NOISE, FEEL, TUNING AND APPEARANCE

☐ Power Switch
☐ Slide Pots
☐ Controls, Switches and LEDs
☐ Oscillator Tuning – Fine Tune and Beat ± 0.25

4. PRESET NO. 1 VOX HUMANA

☐ Output from Each 2 Octave Section
☐ Proper Voicing
☐ ATTACK 0 – 10
☐ MODULATION AMOUNT 0 – 10
☐ MODULATION RATE 0 – 10
☐ Beat Rate is Variable
☐ Noise

5. PRESET NO. 2 STRING 1

☐ Output from Each 2 Octave Section
☐ Proper Voicing
☐ ATTACK 0 – 10
☐ MODULATION AMOUNT 0 – 10
☐ Beat Rate is Variable
☐ Noise

6. PRESET NO. 3 STRING 2

☐ Output from Each 2 Octave Section
☐ Proper Voicing
☐ SUSTAIN ON/OFF

6. PRESET NO. 3 STRING 2 (Continued)

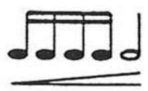
☐ ATTACK 0 - 10
☐ MODULATION AMOUNT 0 - 10
☐ Beat Rate is Variable
☐ Noise

7. PRESET NO. 4 ELECTRIC PIANO

☐ Output from Each 2 Octave Section
☐ Proper Voicing
☐ SUSTAIN ON/OFF
☐ MODULATION AMOUNT 0 - 10
☐ MODULATION RATE 0 - 10
☐ Noise

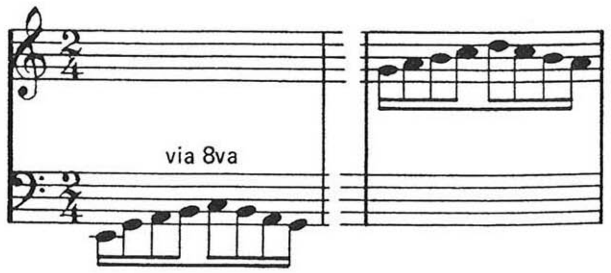
8. PRESET NO. 5 PIANO

☐ Output from Each 2 Octave Section
☐ Proper Voicing
☐ SUSTAIN ON/OFF
☐ MODULATION AMOUNT 0 - 10
☐ MODULATION RATE 0 - 10
☐ Noise
☐ Dynamic Consistency. 3dB Between Notes and 6dB Overall
☐ Dynamic Range and Response to Rapidly Repeated Triggering and Decay Uniformity



(Checks for Cleanliness, Contact Spacing and Backwrap)

☐ Overall Keyboard Response to Fast Runs



9. PRESET NO. 6 HONKY TONK PIANO

☐ Output from Each 2 Octave Section
☐ Proper Voicing
☐ SUSTAIN ON/OFF
☐ MODULATION AMOUNT 0 - 10
☐ MODULATION RATE 0 - 10
☐ Beat Rate is Variable
☐ Noise

10. PRESET NO. 7 CLAVINET

☐ Output from Each 2 Octave Section
☐ Proper Voicing
☐ SUSTAIN ON/OFF
☐ MODULATION AMOUNT 0 - 10
☐ MODULATION RATE 0 - 10
☐ Noise

11. PRESET NO. 8 HARPSICHORD

☐ Output from Each 2 Octave Section
☐ Proper Voicing
☐ SUSTAIN ON/OFF
☐ MODULATION AMOUNT 0 - 10
☐ MODULATION RATE 0 - 10
☐ Beat Rate Variable
☐ Raise Pitch One Octave with Pedal. Check for Normal Output of /|/| and ⎍ Waves.
☐ Noise

12. PRESET NO. 9 BRASS

☐ Output from Each 2 Octave Section
☐ Control of VCF Cutoff Frequency with Pedal
☐ Proper Voicing
☐ Single - Multiple Trigger of VCF with Rear Panel Switch
☐ SUSTAIN ON/OFF (Very Short)
☐ MODULATION AMOUNT 0 - 10
☐ MODULATION RATE 0 - 10

12. PRESET NO. 9 BRASS (Continued)

☐ Bass Filter ON/Off
☐ Bass Level and Cutoff 60Hz - 300Hz
☐ Octave Balance Sliders
☐ Swell Range 28dB
☐ Volume Slider
☐ Fine Tune
☐ /|/| Presence and Clarity Each Note
☐ Ribbon Smoothness of Performance
☐ Ribbon Does Not Affect Pitch Before and After Use
☐ Ribbon Centering and Range
☐ Noise

13. PRESET NO. 10 BRASS CHORUS

☐ Ribbon Oscillator Tracking with Modulation Amount at 0
☐ Output from Each 2 Octave Section
☐ Proper Voicing
☐ SUSTAIN ON/OFF (Very Short Sustain)
☐ MODULATION AMOUNT 0 - 10
☐ MODULATION RATE 0 - 10
☐ ATTACK 0 - 10
☐ Noise

14. PRESET NO. 11 PIPE ORGAN

☐ Output from Each 2 Octave Section
☐ Proper Voicing
☐ SUSTAIN ON/OFF
☐ MODULATION AMOUNT 0 - 10
☐ MODULATION RATE 0 - 10
☐ ATTACK 0 - 10
☐ Noise

15. PRESET NO. 12 ROCK ORGAN

☐ Output from Each 2 Octave Section
☐ Proper Voicing
☐ SUSTAIN ON/OFF
☐ MODULATION AMOUNT 0 - 10
☐ MODULATION RATE 0 - 10
☐ Noise

16. PRESET NO. 13 VIBES

☐ Output from Each 2 Octave Section
☐ Proper Voicing
☐ SUSTAIN ON/OFF
☐ MODULATION AMOUNT 0 - 10
☐ MODULATION RATE 0 - 10
☐ ⎍⎍Presence and Clarity Each Note With MODULATION OFF
☐ Noise

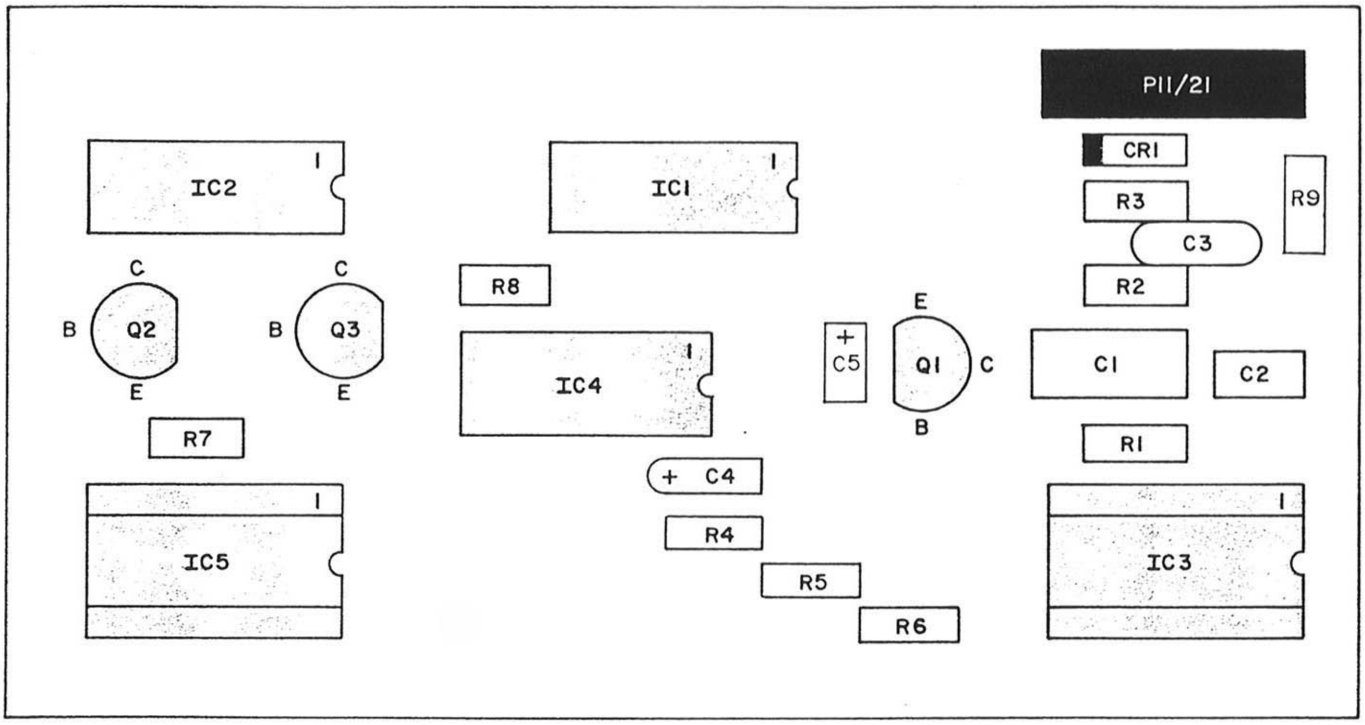
17. PRESET NO. 14 FUNK

☐ Output from Each 2 Octave Section
☐ Proper Voicing
☐ SUSTAIN ON/OFF
☐ MODULATION AMOUNT 0 - 10
☐ MODULATION RATE 0 - 10
☐ Noise

18. FINAL CHECK

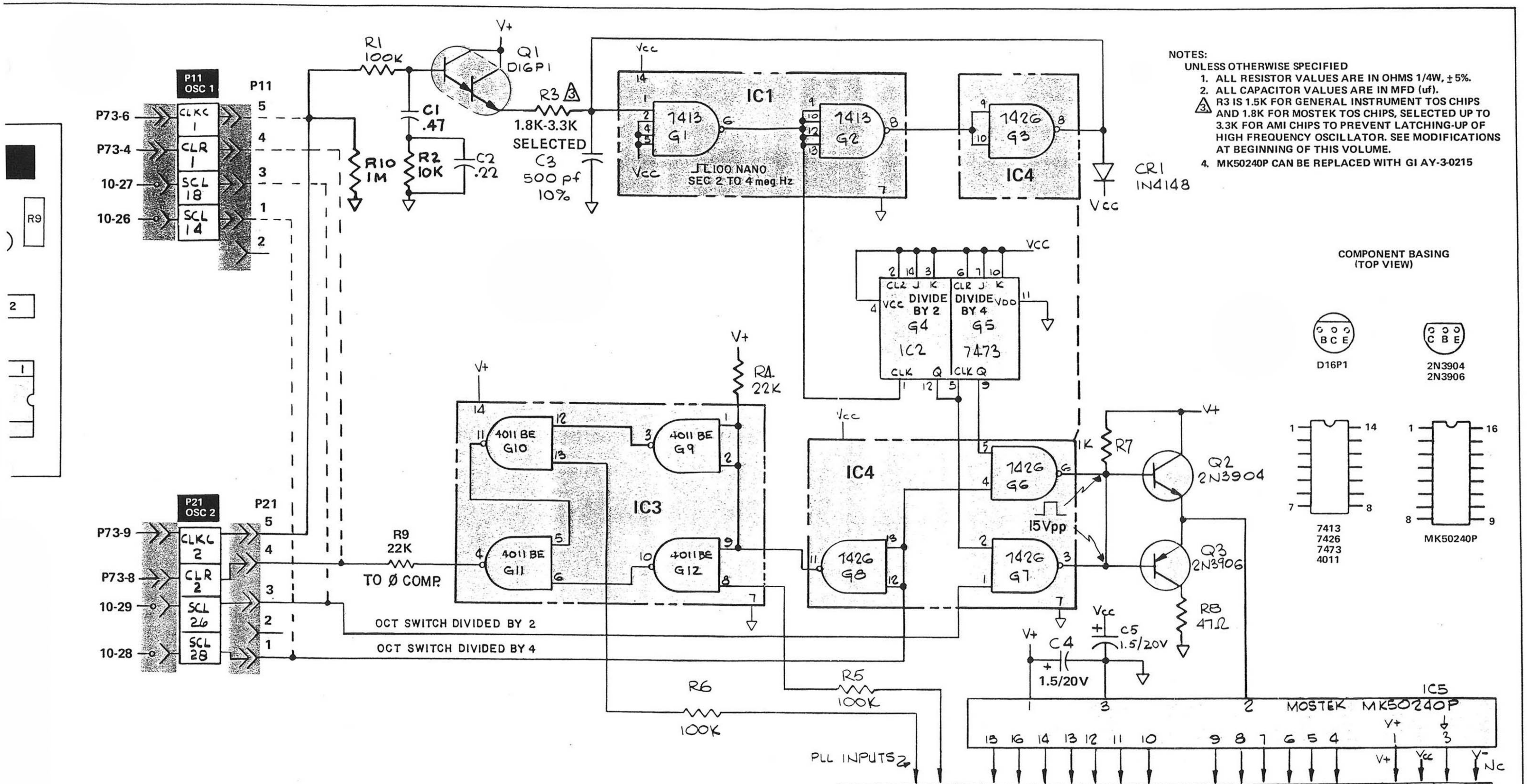
☐ Power Supply Voltages
☐ Oscillator Tuning

NOTE:
REFER TO THE REPLACEMENT PARTS LIST IN VOLUME 1, SECTION 2 FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.



P11/21
CR1
R9
R3
C3
R2
C1
C2
R1
IC2
IC1
IC3
IC4
IC5
1
Q1
Q2
Q3
C
B
E
R7
R8
C5
C4
+
R4
R5
R6

REV	DESCRIPTION	EO
A	REVISED FOR C-B KEYBOARD	
B	REVISED FOR F-E KEYBOARD	
C	RELEASED FOR PRODUCTION	0192
D	CHANGED R3 FROM 1.3K TO 1.8K	0388
E	CHANGED R3 FROM 1.8K TO 1.8K-3.3K SELECTED	0420
F	ADDED P11 WIRE DESTINATIONS	0617
G	ADDED TANT. CAPACITOR C5 1.5UF/20V	0630
H	CHANGED R3 PER EO0678	0678
J	CHANGED IC3 FROM 4011AE TO 4011BE; ADDED RESISTOR R9, 10K, 1/4W, ± 5%	0726
K	NEXT ASS'Y WAS, 981-040151	0790
L	ADD 1 MEG RESISTOR FROM P111-5 (P21-5) TO GROUND	1191


P11
OSC 1
P73-6
P73-4
10-27
10-26
CLKC 1
CLR 1
SCL 18
SCL 14
R9
2
1
R1 100K
V+
Q1 D16P1
C1 .47
R10 1M
R2 10K
C2 .22
R3 1.8K-3.3K SELECTED
C3 500 pf 10%
Vcc
IC1
7413 G1
7413 G2
100 NANO SEC 2 TO 4 meg Hz
7426 G3
IC4
CR1 1N4148
VCC
DIVIDE BY 2 G4 IC2
DIVIDE BY 4 G5 7473
CLK J K
CLR J K
VDD
V+
R4 22K
4011 BE G10
4011 BE G9
4011 BE G11
4011 BE G12
IC3
7426 G6
7426 G8
7426 G7
15Vpp
1K R7
Q2 2N3904
Q3 2N3906
R8 47Ω
P21
OSC 2
P73-9
P73-8
10-29
10-28
CLKC 2
CLR 2
SCL 26
SCL 28
R9 22K
TO Ø COMP.
OCT SWITCH DIVIDED BY 2
OCT SWITCH DIVIDED BY 4
C4 1.5/20V
C5 1.5/20V
R6 100K
R5 100K
IC5
MOSTEK MK50240P
PLL INPUTS
V+
Vcc
V-
NC
COMPONENT BASING (TOP VIEW)
B C E
D16P1
C B E
2N3904
2N3906
7413
7426
7473
4011
MK50240P

NOTES:
UNLESS OTHERWISE SPECIFIED
1. ALL RESISTOR VALUES ARE IN OHMS 1/4W, ± 5%.
2. ALL CAPACITOR VALUES ARE IN MFD (uf).
3. R3 IS 1.5K FOR GENERAL INSTRUMENT TOS CHIPS AND 1.8K FOR MOSTEK TOS CHIPS, SELECTED UP TO 3.3K FOR AMI CHIPS TO PREVENT LATCHING-UP OF HIGH FREQUENCY OSCILLATOR. SEE MODIFICATIONS AT BEGINNING OF THIS VOLUME.
4. MK50240P CAN BE REPLACED WITH GI AY-3-0215

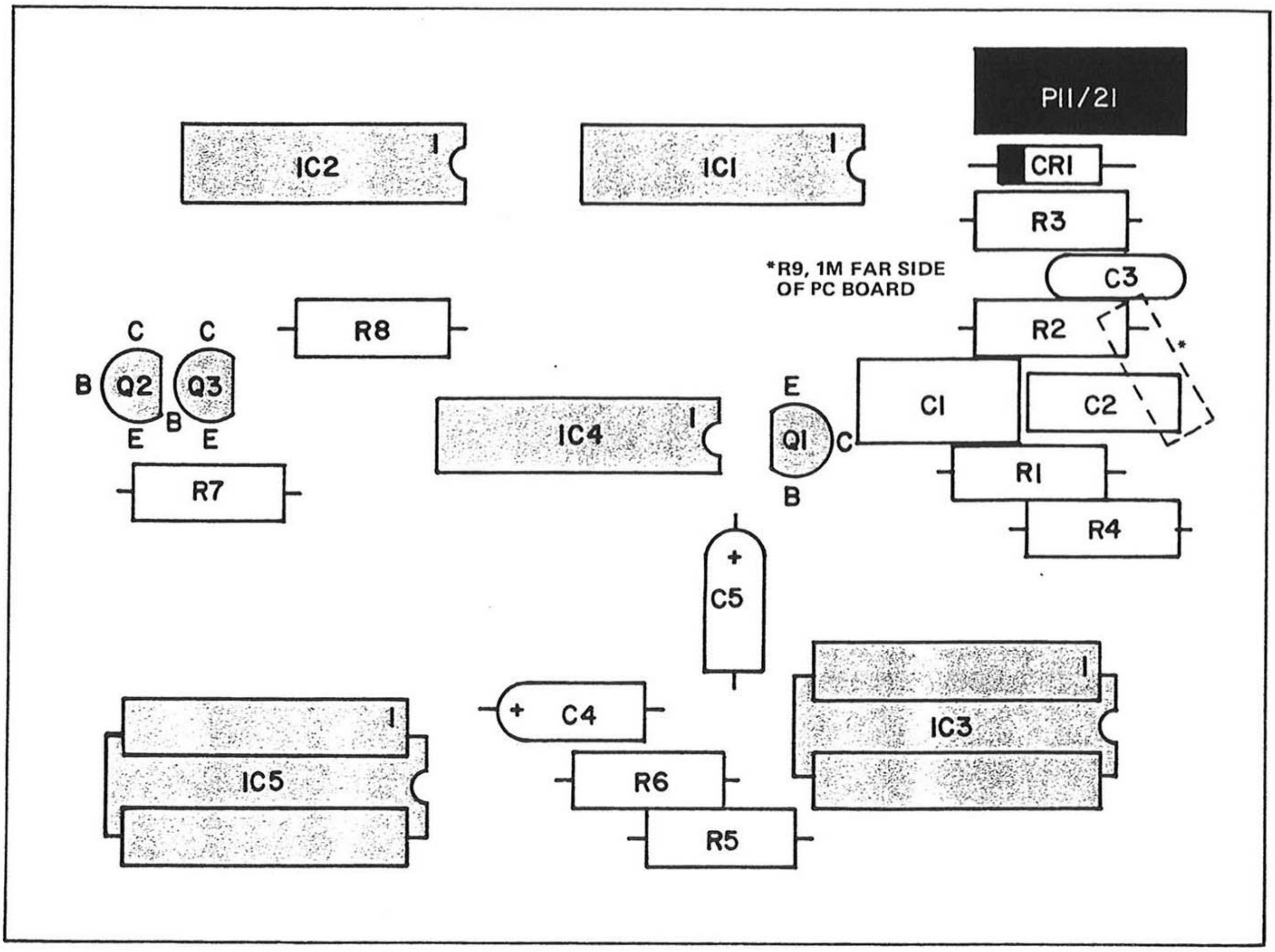
	PIN#	11	12		7	8	6	5	4	3	2		1	20	19	18	10	9		13	14	15	16
RIGHT HAND BOARD NO. 1	OSC 1	T60	T48			T61	T72	T71	T70	T69	T68		T67	T66	T65	T64	T63	T62		+15	+5	GND	-15
LEFT HAND BOARD NO. 2	OSC 2	N72	N60		N84	N72	N83	N82	N81	N80	N79		N78	N77	N76	N75	N74	N73					

NOTE: This Version not to be used as Sawtooth Rank No. 1 HFO on Polymoog Keyboard.

996-042153
HFO BOARDS 1, 2

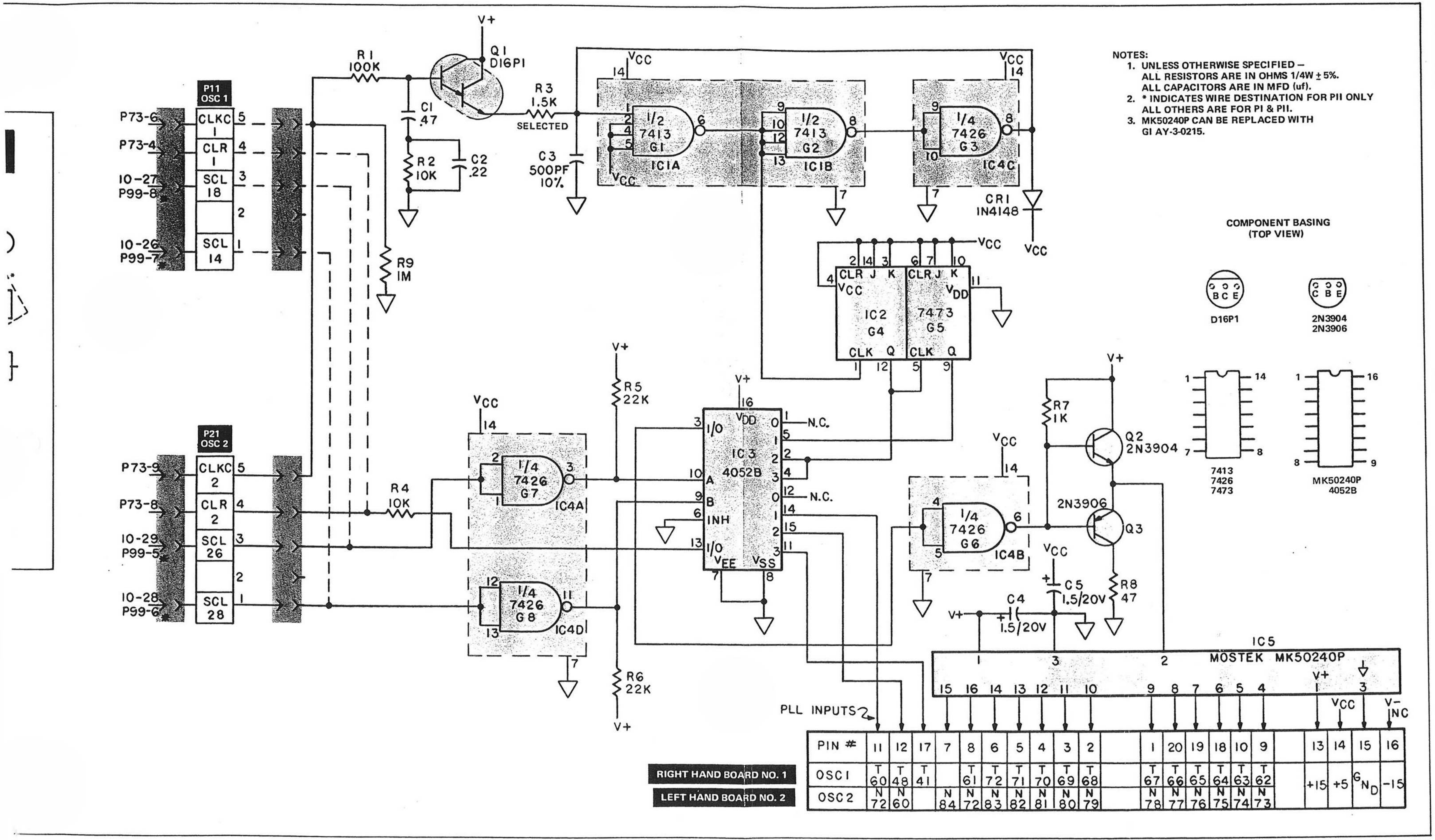
HIGH FREQUENCY OSCILLATOR SCHEMATIC DIAGRAM HFO BOARDS 1, 2 (VERSION 1)

NOTE:
REFER TO THE REPLACEMENT PARTS LIST IN VOLUME 1, SECTION 2 FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.


*R9, 1M FAR SIDE OF PC BOARD
P11/21
CR1
IC2
IC1
1
R3
C3
R8
R2
C
B
Q2
Q3
E
IC4
Q1
C1
C2
R1
R7
R4
+
C5
C4
IC3
IC5
R6
R5

REV	DESCRIPTION	EO
A	RELEASED FOR PRODUCTION	0842
B	R3, SEL WAS 1.5K	0947
C	ADDED R9, 1M	1191

996-042870
HFO BOARDS 1, 2

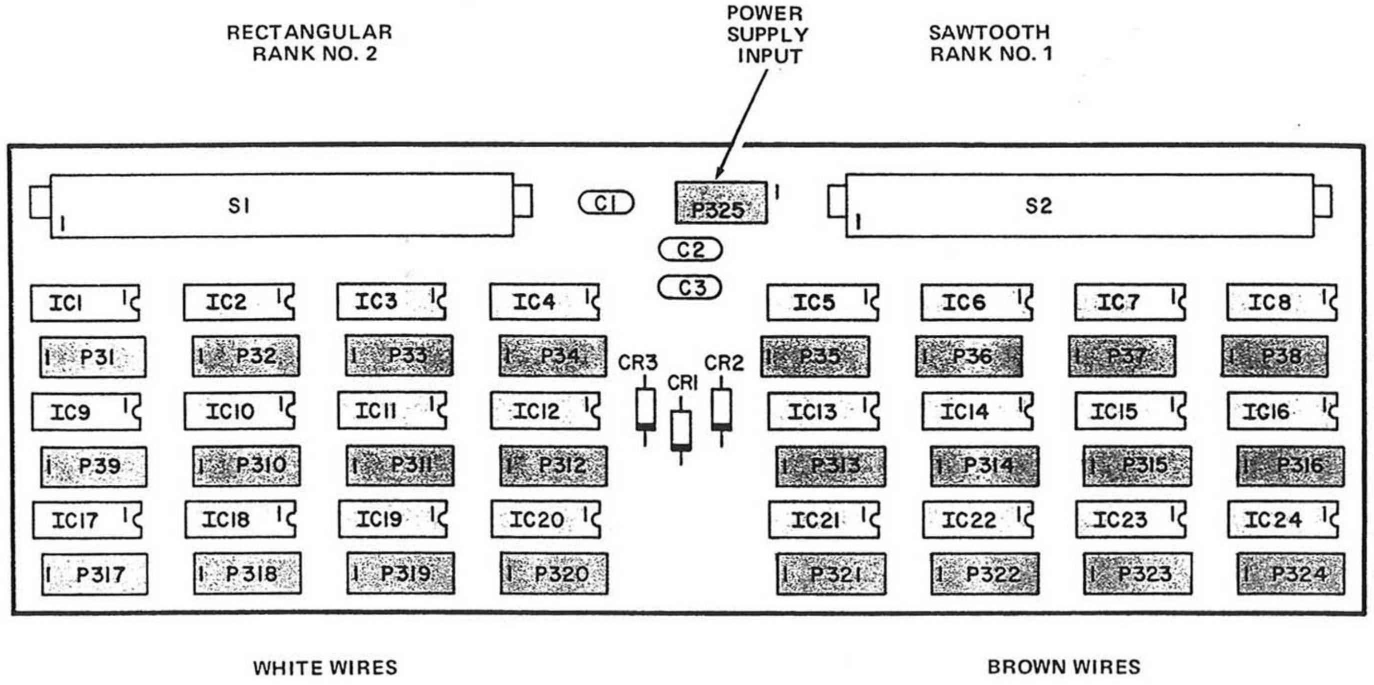

V+
Q1
D16P1
R1
100K
R3
1.5K
SELECTED
C1
.47
R2
10K
C2
.22
C3
500PF
10%
P11
OSC 1
P73-6
P73-4
10-27
P99-8
10-26
P99-7
CLKC 1
CLR 1
SCL 18
SCL 14
R9
1M
VCC
1/2 7413 G1
IC1A
1/2 7413 G2
IC1B
1/4 7426 G3
IC4C
CR1
1N4148
CLR J K
VCC
IC2
G4
7473
G5
VDD
CLK Q
COMPONENT BASING
(TOP VIEW)
B C E
D16P1
C B E
2N3904
2N3906
7413
7426
7473
MK50240P
4052B
P21
OSC 2
P73-9
P73-8
10-29
P99-5
10-28
P99-6
CLKC 2
CLR 2
SCL 26
SCL 28
R4
10K
1/4 7426 G7
IC4A
1/4 7426 G8
IC4D
R5
22K
R6
22K
IC3
4052B
I/O
A
B
INH
VDD
VEE
VSS
N.C.
R7
1K
Q2
2N3904
2N3906
Q3
1/4 7426 G6
IC4B
C5
1.5/20V
C4
1.5/20V
R8
47
IC5
MOSTEK MK50240P
PLL INPUTS
V-
NC
RIGHT HAND BOARD NO. 1
LEFT HAND BOARD NO. 2

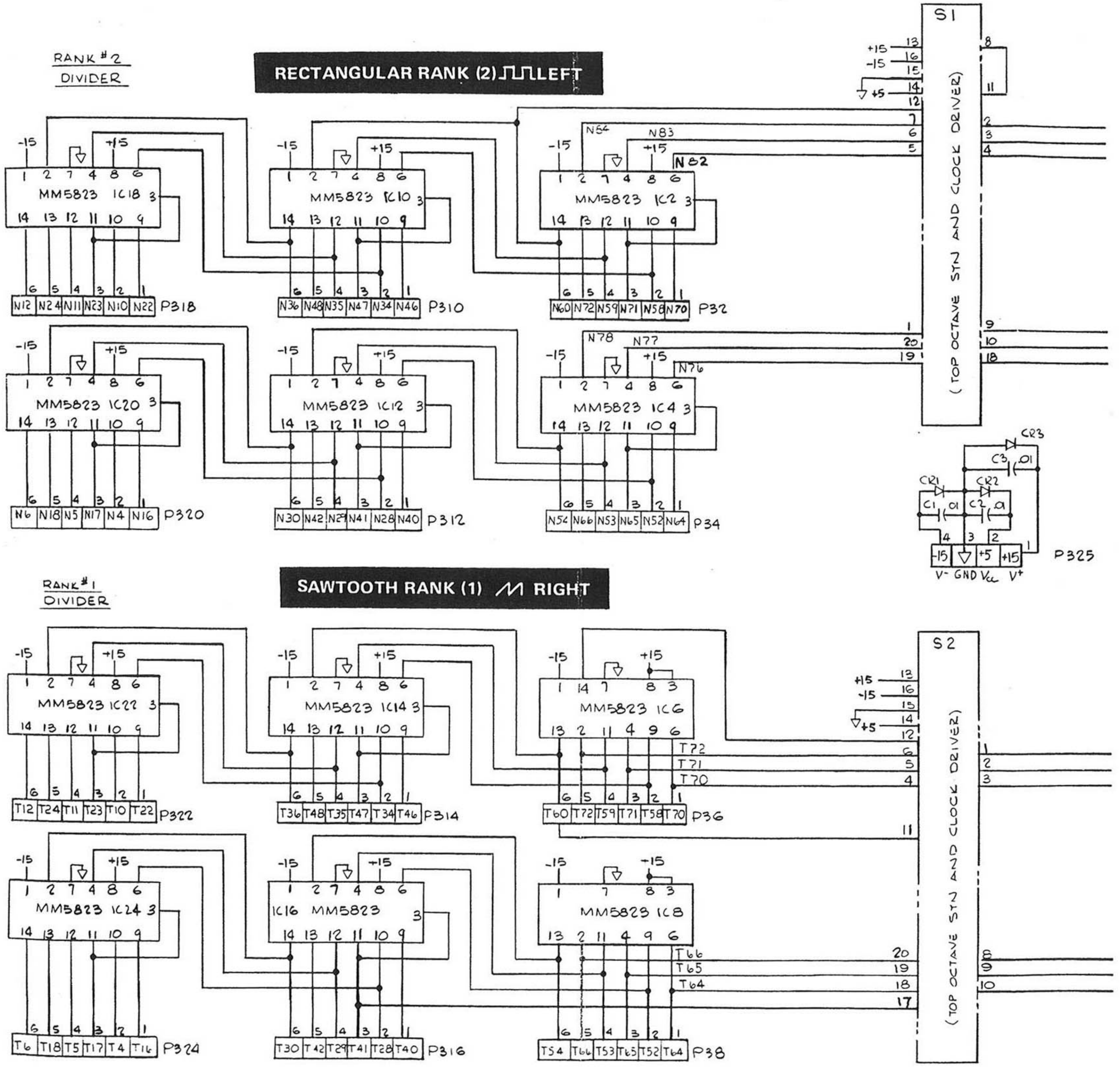
NOTES:
1. UNLESS OTHERWISE SPECIFIED –
ALL RESISTORS ARE IN OHMS 1/4W ± 5%.
ALL CAPACITORS ARE IN MFD (uf).
2. * INDICATES WIRE DESTINATION FOR PII ONLY
ALL OTHERS ARE FOR PI & PII.
3. MK50240P CAN BE REPLACED WITH
GI AY-3-0215.

PIN #	11	12	17	7	8	6	5	4	3	2		1	20	19	18	10	9		13	14	15	16
OSC1	T 60	T 48	T 41		T 61	T 72	T 71	T 70	T 69	T 68		T 67	T 66	T 65	T 64	T 63	T 62		+15	+5	GND	-15
OSC2	N 72	N 60		N 84	N 72	N 83	N 82	N 81	N 80	N 79		N 78	N 77	N 76	N 75	N 74	N 73					

HIGH FREQUENCY OSCILLATOR SCHEMATIC DIAGRAM HFO BOARDS 1, 2 (VERSION 2)

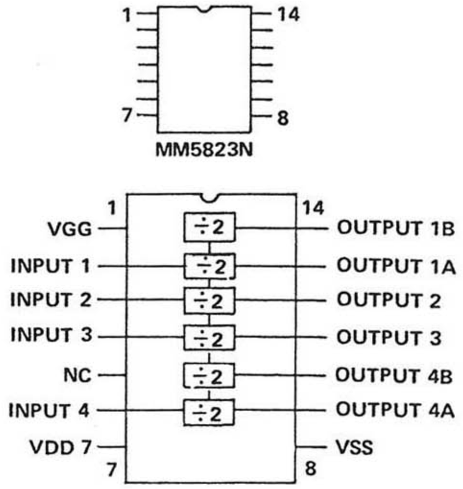
NOTE:
REFER TO THE REPLACEMENT PARTS LIST IN VOLUME 1, SECTION 2 FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.


RECTANGULAR RANK NO. 2
POWER SUPPLY INPUT
SAWTOOTH RANK NO. 1
S1
S2
C1
C2
C3
P325
CR1
CR2
CR3
IC1 IC2 IC3 IC4 IC5 IC6 IC7 IC8
P31 P32 P33 P34 P35 P36 P37 P38
IC9 IC10 IC11 IC12 IC13 IC14 IC15 IC16
P39 P310 P311 P312 P313 P314 P315 P316
IC17 IC18 IC19 IC20 IC21 IC22 IC23 IC24
P317 P318 P319 P320 P321 P322 P323 P324
WHITE WIRES
BROWN WIRES

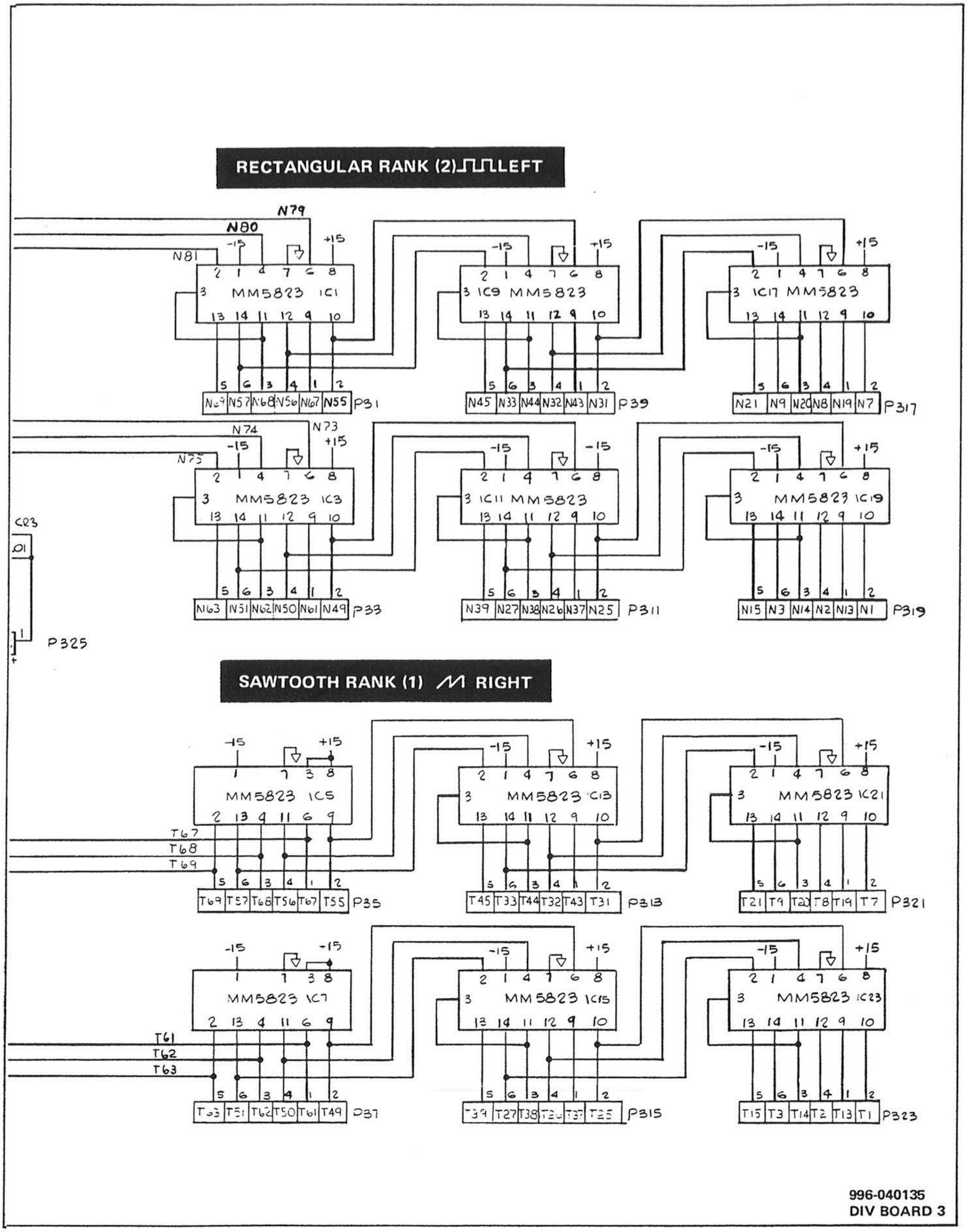

RANK #2 DIVIDER
RECTANGULAR RANK (2) ⎍⎍ LEFT
MM5823 IC18
MM5823 IC10
MM5823 IC2
MM5823 IC20
MM5823 IC12
MM5823 IC4
-15
+15
N12 N24 N11 N23 N10 N22 P318
N36 N48 N35 N47 N34 N46 P310
N60 N72 N59 N71 N58 N70 P32
N6 N18 N5 N17 N4 N16 P320
N30 N42 N29 N41 N28 N40 P312
N54 N66 N53 N65 N52 N64 P34
N54 N83 N82 N78 N77 N76
S1
(TOP OCTAVE SYN AND CLOCK DRIVER)
+5
CR1 CR2 CR3
C1 .01 C2 .01 C3 .01
-15 +5 +15
V- GND Vcc V+
P325
RANK #1 DIVIDER
SAWTOOTH RANK (1) ⩘ RIGHT
MM5823 IC22
MM5823 IC14
MM5823 IC6
MM5823 IC24
IC16 MM5823
MM5823 IC8
T12 T24 T11 T23 T10 T22 P322
T36 T48 T35 T47 T34 T46 P314
T60 T72 T59 T71 T58 T70 P36
T6 T18 T5 T17 T4 T16 P324
T30 T42 T29 T41 T28 T40 P316
T54 T66 T53 T65 T52 T64 P38
T72 T71 T70 T66 T65 T64
S2
(TOP OCTAVE SYN AND CLOCK DRIVER)

NOTES: UNLESS OTHERWISE SPECIFIED –
1. ALL CAPACITOR VALUES ARE IN MFD (uf).
2. ALL DIODES ARE 1N4004.
3. N AND T SUFFIXES INDICATE NOTE NUMBER, 1 BEING LOWEST NOTE ON KEYBOARD.
4. MM5823 MAY BE REPLACED WITH 991-042015-001 OR 991-025539-002.

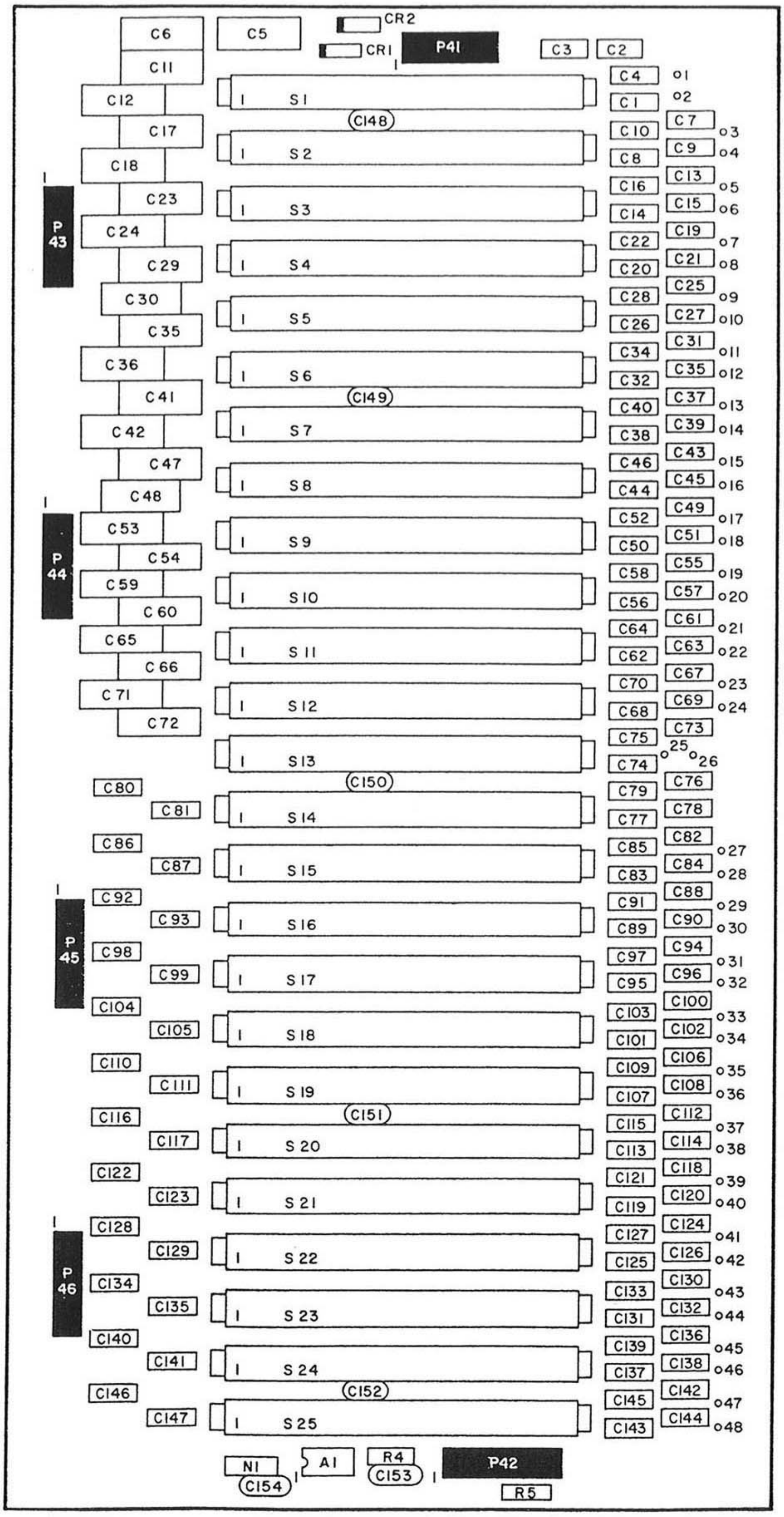
COMPONENT BASING (TOP VIEW)


1
14
7
8
MM5823N
VGG
INPUT 1
INPUT 2
INPUT 3
NC
INPUT 4
VDD 7
÷2
OUTPUT 1B
OUTPUT 1A
OUTPUT 2
OUTPUT 3
OUTPUT 4B
OUTPUT 4A
VSS

REV	DESCRIPTION	EO
A	REVISED FOR C-B KEYBOARD	
B	REVISED FOR F-E KEYBOARD	
C	RELEASED FOR PRODUCTION	0192
D	NEXT ASS'Y WAS 981-040133	0790
E	ADDED WIRE FROM S2-17 TO P316-3	0842


RECTANGULAR RANK (2) ⎍⎍ LEFT
N79
N80
N81
N74
N73
N75
-15
+15
MM5823 IC1
MM5823 IC9
MM5823 IC17
MM5823 IC3
MM5823 IC11
MM5823 IC19
N69 N57 N68 N56 N67 N55 P31
N45 N33 N44 N32 N43 N31 P39
N21 N9 N20 N8 N19 N7 P317
N63 N51 N62 N50 N61 N49 P33
N39 N27 N38 N26 N37 N25 P311
N15 N3 N14 N2 N13 N1 P319
C23
.01
P325
SAWTOOTH RANK (1) ⩘ RIGHT
MM5823 IC5
MM5823 IC13
MM5823 IC21
MM5823 IC7
MM5823 IC15
MM5823 IC23
T67
T68
T69
T61
T62
T63
T69 T57 T68 T56 T67 T55 P35
T45 T33 T44 T32 T43 T31 P313
T21 T9 T20 T8 T19 T7 P321
T63 T51 T62 T50 T61 T49 P37
T39 T27 T38 T26 T37 T25 P315
T15 T3 T14 T2 T13 T1 P323
996-040135
DIV BOARD 3

DIVIDER SCHEMATIC DIAGRAM DIV BOARD 3


C6
C5
CR2
CR1
P41
C3
C2
C11
C4
1
C1
2
C12
S1
C148
C7
3
C17
C10
C9
4
S2
C8
C18
C13
C16
5
C23
S3
C15
6
C14
P 43
C24
C19
7
C22
C29
S4
C21
8
C20
C25
C30
C28
9
S5
C27
10
C35
C26
C31
11
C36
C34
S6
C35
12
C32
C41
C149
C37
13
C40
C42
S7
C39
14
C38
C47
C43
15
C46
S8
C45
16
C48
C44
C49
C53
C52
17
S9
C51
18
P 44
C50
C54
C55
19
C58
C59
S10
C57
20
C60
C56
C61
21
C64
C65
S11
C63
22
C62
C66
C67
23
C70
C71
S12
C69
24
C68
C72
C73
C75
25
26
S13
C74
C150
C80
C76
C79
C81
S14
C78
C77
C86
C82
C85
27
C87
S15
C84
28
C83
C92
C88
29
C91
P 45
C93
S16
C90
30
C89
C98
C94
C97
31
C99
S17
C96
32
C95
C104
C100
C103
33
C105
S18
C102
34
C101
C110
C106
C109
35
C111
S19
C108
36
C107
C116
C151
C112
C115
37
C117
S 20
C114
38
C113
C122
C118
C121
39
C123
S 21
C120
40
C119
C128
C124
C127
41
P 46
C129
S 22
C126
42
C125
C134
C130
C133
43
C135
S 23
C132
44
C131
C140
C136
C139
45
C141
S 24
C138
46
C137
C146
C152
C142
C145
47
C147
S 25
C144
48
C143
N1
A1
R4
C153
P42
C154
R5

NOTE:
REFER TO THE REPLACEMEN
IN VOLUME 1, SECTION 3 FO
NUMBER AND DESCRIPTION
REFERENCE DESIGNATOR.

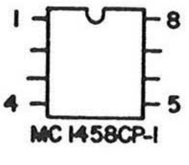
NOTE:
WHITE WIRES – RECTANGUL
RANK (NO. 2).
BROWN WIRES – SAWTOOTH
RANK (NO. 1).

(*P98-6)

(*P1011-1)P1

NOTES: UNLESS OTHERWISE
SPECIFIED -
1. ALL RESISTOR VALUES A
IN OHMS 1/4W, ±5%.
2. ALL CAPACITOR VALUES
ARE IN MFD (uf).
3. ALL DIODES ARE 1N4004.
4. N AND T SUFFIXES INDIC
NOTE NUMBER, 1 BEING LOW-
EST NOTE ON KEYBOARD.
* POLYMOOG KEYBOARD

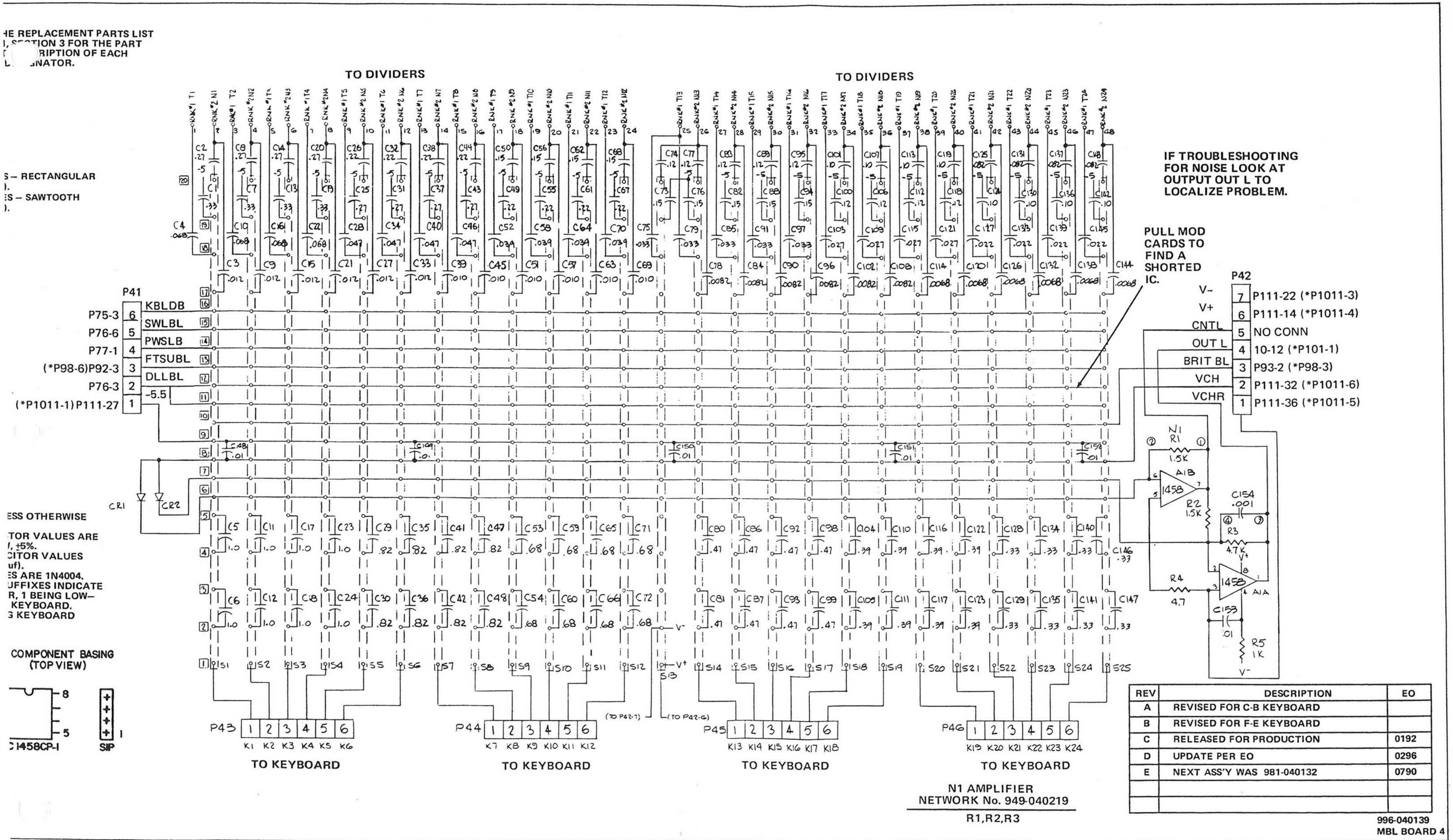
COMPONENT B
(TOP VIEW)


1
8
4
5
MC 1458CP-1

HE REPLACEMENT PARTS LIST
I, SECTION 3 FOR THE PART
RIPTION OF EACH
GNATOR.

S – RECTANGULAR
).
ES – SAWTOOTH
).

ESS OTHERWISE
TOR VALUES ARE
, ±5%.
CITOR VALUES
uf).
ES ARE 1N4004.
UFFIXES INDICATE
R, 1 BEING LOW–
KEYBOARD.
3 KEYBOARD



TO DIVIDERS
TO DIVIDERS
IF TROUBLESHOOTING FOR NOISE LOOK AT OUTPUT OUT L TO LOCALIZE PROBLEM.
PULL MOD CARDS TO FIND A SHORTED IC.
P41
P75-3 6 KBLDB
P76-6 5 SWLBL
P77-1 4 PWSLB
(*P98-6)P92-3 3 FTSUBL
P76-3 2 DLLBL
(*P1011-1)P111-27 1 -5.5
P42
V- 7 P111-22 (*P1011-3)
V+ 6 P111-14 (*P1011-4)
CNTL 5 NO CONN
OUT L 4 10-12 (*P101-1)
BRIT BL 3 P93-2 (*P98-3)
VCH 2 P111-32 (*P1011-6)
VCHR 1 P111-36 (*P1011-5)
N1 R1 1.5K
A1B 1458
R2 1.5K
C154 .001
R3 4.7K
R4 4.7
1458 A1A
C153 .01
R5 1K
V+
V-
CR1
CR2
C148 .01
C149 .01
C150 .01
C151 .01
C152 .01
S1 S2 S3 S4 S5 S6 S7 S8 S9 S10 S11 S12 S13 S14 S15 S16 S17 S18 S19 S20 S21 S22 S23 S24 S25
P43 1 2 3 4 5 6
K1 K2 K3 K4 K5 K6
P44 1 2 3 4 5 6
K7 K8 K9 K10 K11 K12
(TO P42-7)
(TO P42-6)
P45 1 2 3 4 5 6
K13 K14 K15 K16 K17 K18
P46 1 2 3 4 5 6
K19 K20 K21 K22 K23 K24
TO KEYBOARD
TO KEYBOARD
TO KEYBOARD
TO KEYBOARD
COMPONENT BASING (TOP VIEW)
8
5
1
1458CP-1
SIP

N1 AMPLIFIER
NETWORK No. 949-040219

R1,R2,R3

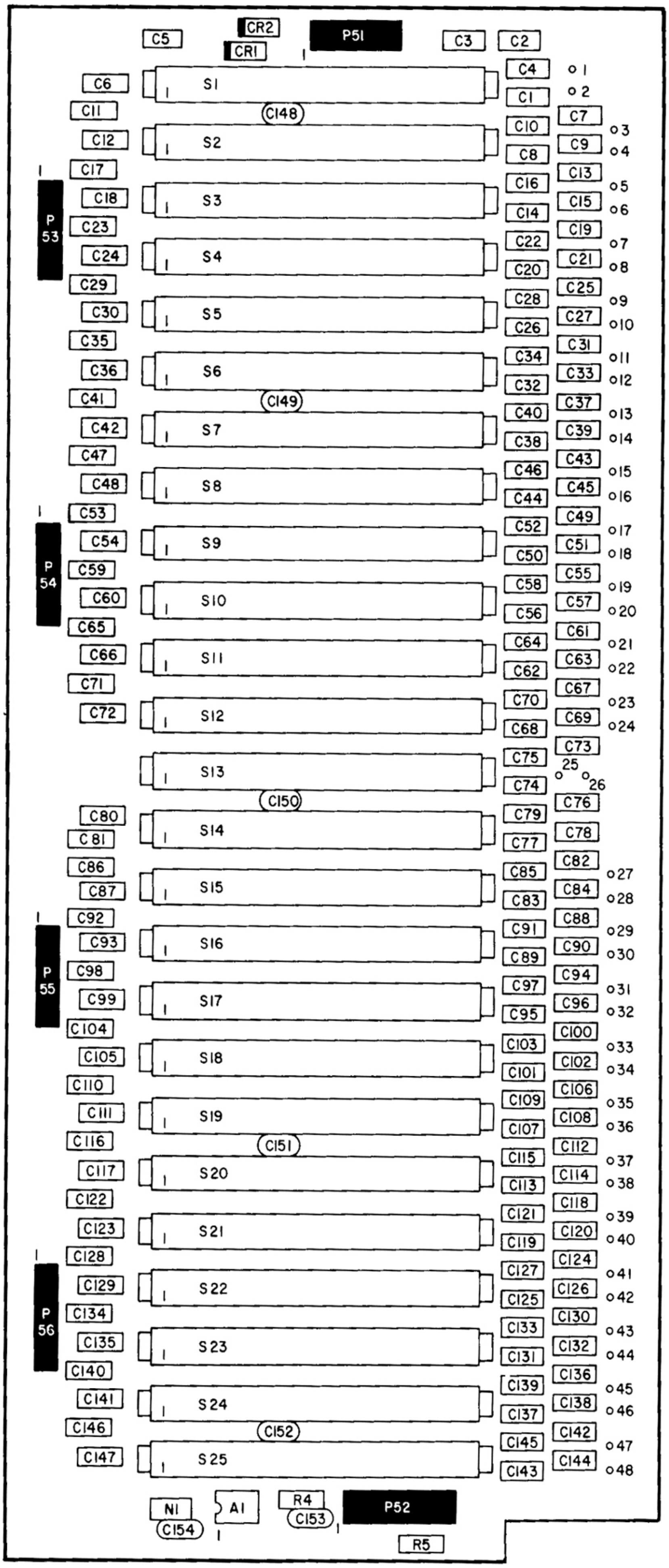
REV	DESCRIPTION	EO
A	REVISED FOR C-B KEYBOARD	
B	REVISED FOR F-E KEYBOARD	
C	RELEASED FOR PRODUCTION	0192
D	UPDATE PER EO	0296
E	NEXT ASS'Y WAS 981-040132	0790

996-040139
MBL BOARD 4

LOW MOTHER BOARD SCHEMATIC DIAGRAM MBL BOARD 4

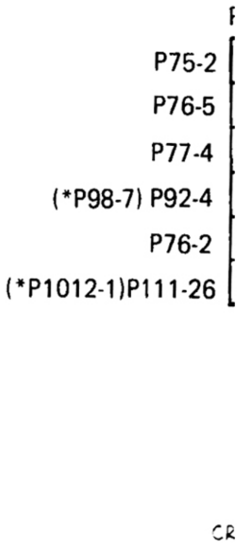
1	2	3	4	5	6	7	14
8	9	10	11	12	13	14	

1	2	3	4	5	9
6	7	8	9	•	


CR2
P51
C5
CRI
C3
C2
C4
C1
C6
S1
C148
C11
C12
S2
C10
C8
C7
C9
C17
P 53
C18
S3
C16
C14
C13
C15
C23
C24
S4
C22
C20
C19
C21
C29
C30
S5
C28
C26
C25
C27
C35
C36
S6
C34
C32
C31
C33
C41
C149
C42
S7
C40
C38
C37
C39
C47
C48
S8
C46
C44
C43
C45
C53
P 54
C54
S9
C52
C50
C49
C51
C59
C60
S10
C58
C56
C55
C57
C65
C66
S11
C64
C62
C61
C63
C71
C72
S12
C70
C68
C67
C69
S13
C75
C74
C73
C150
C80
C81
S14
C79
C77
C76
C78
C86
C87
S15
C85
C83
C82
C84
C92
P 55
C93
S16
C91
C89
C88
C90
C98
C99
S17
C97
C95
C94
C96
C104
C105
S18
C103
C101
C100
C102
C110
C111
S19
C109
C107
C106
C108
C116
C151
C117
S20
C115
C113
C112
C114
C122
C123
S21
C121
C119
C118
C120
C128
P 56
C129
S22
C127
C125
C124
C126
C134
C135
S23
C133
C131
C130
C132
C140
C141
S24
C139
C137
C136
C138
C146
C152
C147
S25
C145
C143
C142
C144
N1
C154
A1
R4
C153
P52
R5
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48

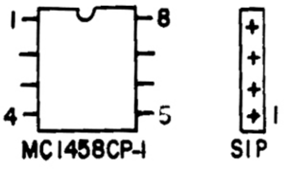
NOTE:
REFER TO THE REPLACEMENT PARTS LI
IN VOLUME 1, SECTION 3 FOR THE PART
NUMBER AND DESCRIPTION OF EACH
REFERENCE DESIGNATOR.

NOTE:
WHITE WIRES – RECTANGULAR RANK (NO. 2).
BROWN WIRES – SAWTOOTH RANK (NO. 1).


P75-2
P76-5
P77-4
(*P98-7) P92-4
P76-2
(*P1012-1)P111-26
CR

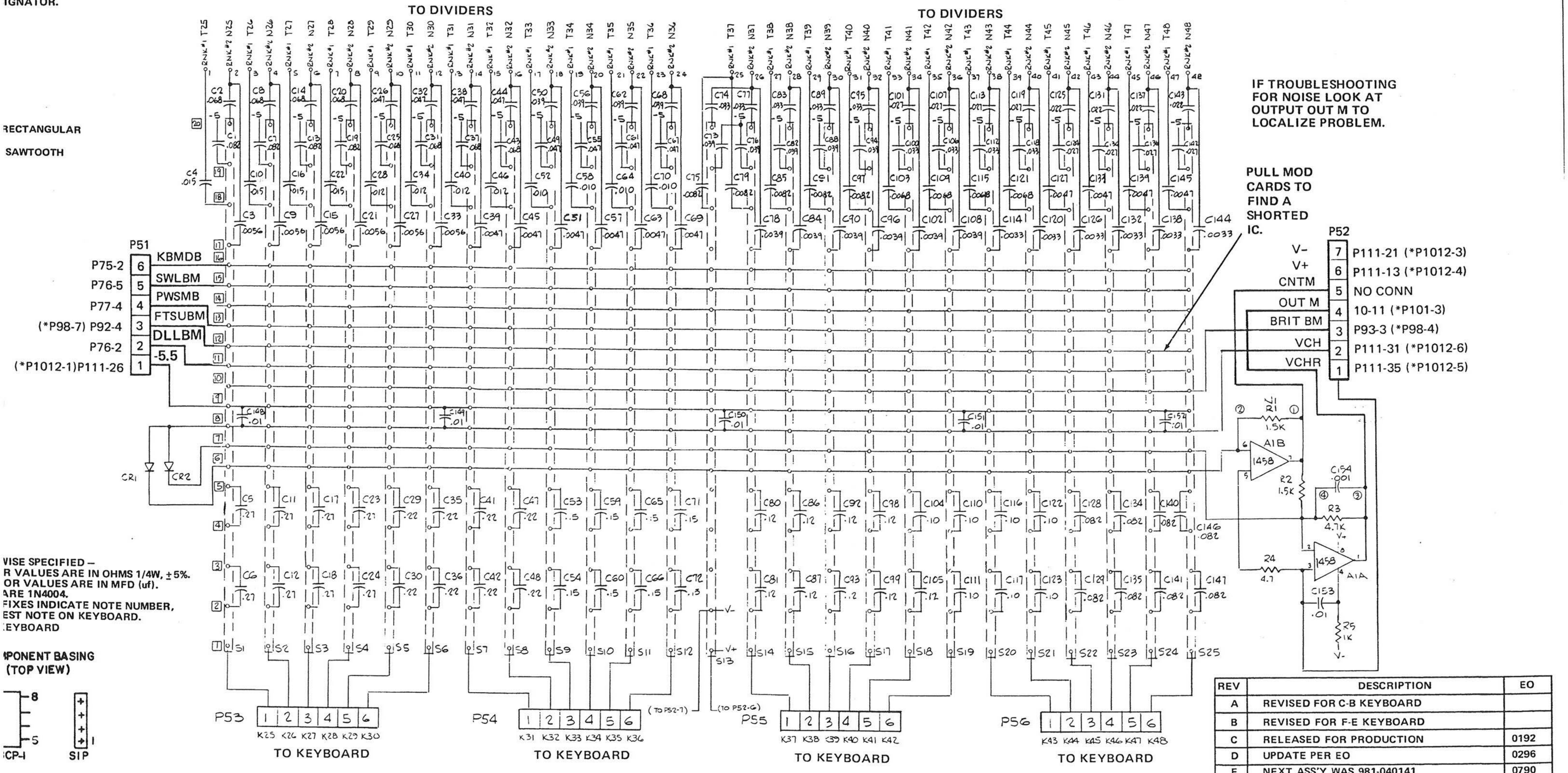
NOTES:
UNLESS OTHERWISE SPECIFIED –
1. **ALL RESISTOR VALUES ARE IN OHMS**
2. **ALL CAPACITOR VALUES ARE IN MFD**
3. **ALL DIODES ARE 1N4004.**
4. **N AND T SUFFIXES INDICATE NOTE N**
   1 BEING LOWEST NOTE ON KEYBOARI
- * **POLYMOOG KEYBOARD**

COMPONENT BASING
(TOP VIEW)


1
8
4
5
MC1458CP-1
+
+
+
+
1
SIP

MEDIUM MOTHER BOARD SCHEMATIC DIAGRAM MBM BOARD 5

EPLACEMENT PARTS LIST
CTION 3 FOR THE PART
SCRIPTION OF EACH
IGNATOR.


RECTANGULAR
SAWTOOTH
TO DIVIDERS
TO DIVIDERS
IF TROUBLESHOOTING FOR NOISE LOOK AT OUTPUT OUT M TO LOCALIZE PROBLEM.
PULL MOD CARDS TO FIND A SHORTED IC.
P51
P75-2 6 KBMDB
P76-5 5 SWLBM
P77-4 4 PWSMB
(*P98-7) P92-4 3 FTSUBM
P76-2 2 DLLBM
(*P1012-1)P111-26 1 -5.5
P52
V- 7 P111-21 (*P1012-3)
V+ 6 P111-13 (*P1012-4)
CNTM 5 NO CONN
OUT M 4 10-11 (*P101-3)
BRIT BM 3 P93-3 (*P98-4)
VCH 2 P111-31 (*P1012-6)
VCHR 1 P111-35 (*P1012-5)
CR1
CR2
R1 1.5K
A1B 1458
R2 1.5K
C154 .001
R3 4.7K
24 4.7
1458 A1A
C153 .01
R5 1K
V-
V+
S1 S2 S3 S4 S5 S6 S7 S8 S9 S10 S11 S12 S13 S14 S15 S16 S17 S18 S19 S20 S21 S22 S23 S24 S25
(TO P52-7)
(TO P52-6)
P53 1 2 3 4 5 6
K25 K26 K27 K28 K29 K30
TO KEYBOARD
P54 1 2 3 4 5 6
K31 K32 K33 K34 K35 K36
TO KEYBOARD
P55 1 2 3 4 5 6
K37 K38 K39 K40 K41 K42
TO KEYBOARD
P56 1 2 3 4 5 6
K43 K44 K45 K46 K47 K48
TO KEYBOARD

VISE SPECIFIED –
R VALUES ARE IN OHMS 1/4W, ± 5%.
OR VALUES ARE IN MFD (uf).
ARE 1N4004.
FIXES INDICATE NOTE NUMBER,
EST NOTE ON KEYBOARD.
EYBOARD

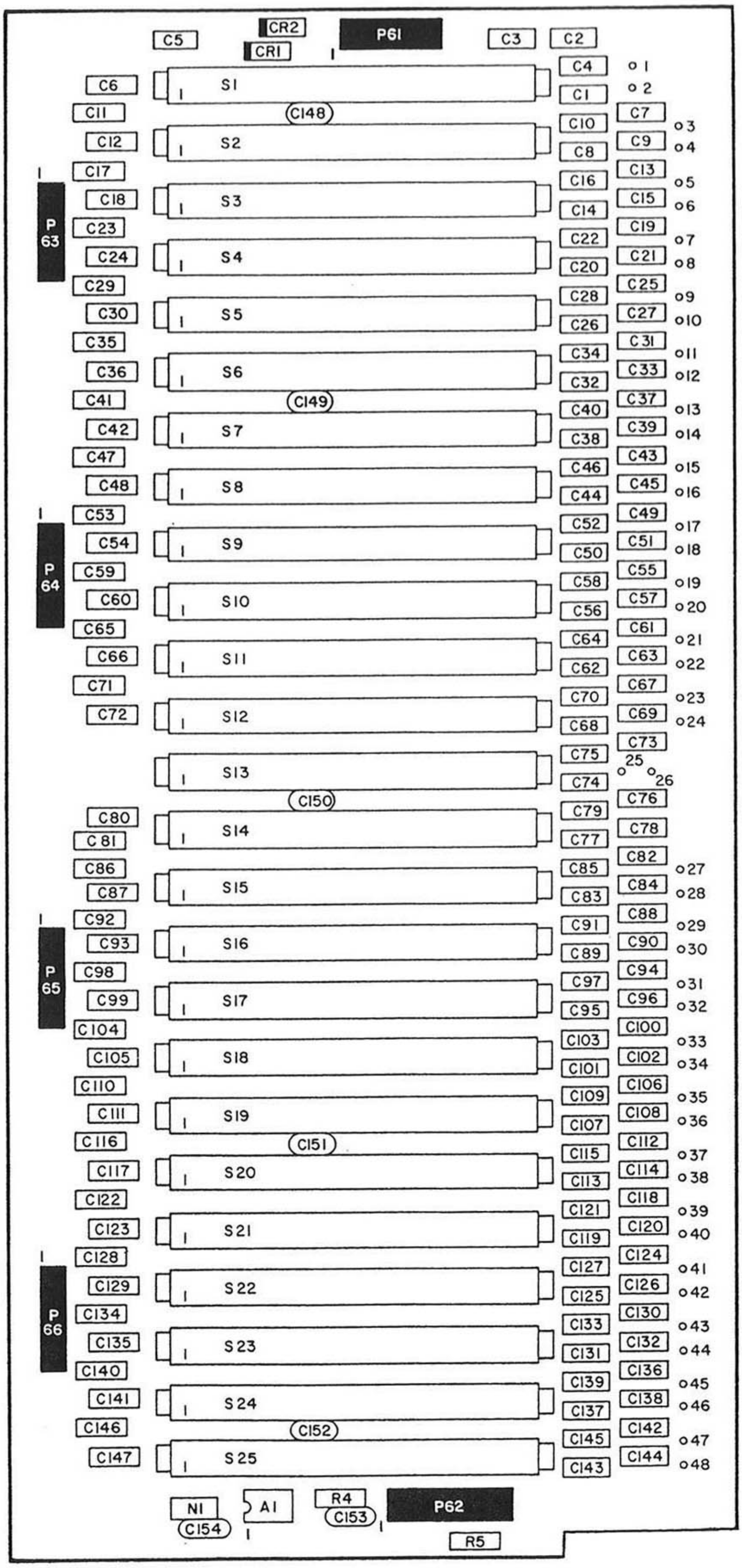
PONENT BASING
(TOP VIEW)

8
5
CP-I
+
+
+
+
1
SIP

REV	DESCRIPTION	EO
A	REVISED FOR C-B KEYBOARD	
B	REVISED FOR F-E KEYBOARD	
C	RELEASED FOR PRODUCTION	0192
D	UPDATE PER EO	0296
E	NEXT ASS'Y WAS 981-040141	0790

N1 AMPLIFIER
NETWORK NO. 949-040219
R1,R2,R3

996-040143
MBM BOARD 5


C5
CR2
CR1
P61
C3
C2
C4
C1
o 1
o 2
S1
C6
C11
C148
C7
C10
o 3
C12
S2
C8
C9
o 4
C17
C13
C16
o 5
P 63
C18
S3
C15
C14
o 6
C23
C19
C22
o 7
C24
S4
C21
C20
o 8
C29
C25
C28
o 9
C30
S5
C27
C26
o 10
C35
C31
C34
o 11
C36
S6
C33
C32
o 12
C41
C149
C37
C40
o 13
C42
S7
C39
C38
o 14
C47
C43
C46
o 15
C48
S8
C45
C44
o 16
C53
C49
C52
o 17
P 64
C54
S9
C51
C50
o 18
C59
C55
C58
o 19
C60
S10
C57
C56
o 20
C65
C61
C64
o 21
C66
S11
C63
C62
o 22
C71
C67
C70
o 23
C72
S12
C69
C68
o 24
C73
C75
o 25
o 26
S13
C74
C150
C76
C80
S14
C79
C78
C77
C81
C82
C86
S15
C85
o 27
C84
C83
o 28
C87
C92
C88
o 29
P 65
C93
S16
C91
C90
C89
o 30
C98
C94
C97
o 31
C99
S17
C96
C95
o 32
C104
C100
C103
o 33
C105
S18
C102
C101
o 34
C110
C106
C109
o 35
C111
S19
C108
C107
o 36
C116
C151
C112
C115
o 37
C117
S20
C114
C113
o 38
C122
C118
C121
o 39
C123
S21
C120
C119
o 40
C128
C124
C127
o 41
P 66
C129
S22
C126
C125
o 42
C134
C130
C133
o 43
C135
S23
C132
C131
o 44
C140
C136
C139
o 45
C141
S24
C138
C137
o 46
C146
C152
C142
C145
o 47
C147
S25
C144
C143
o 48
N1
C154
A1
R4
C153
P62
R5

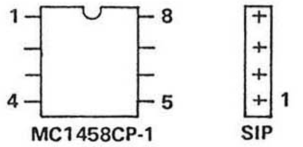
NOTE: REFER TO REPLAC
VOLUME 1, SECTION 3 FO
DESCRIPTION OF EACH R

(*

(*P101

NOTES:
WHITE WIRES – RECTANGULAR
RANK (NO. 2).
BROWN WIRES – SAWTOOTH
RANK (NO. 1).

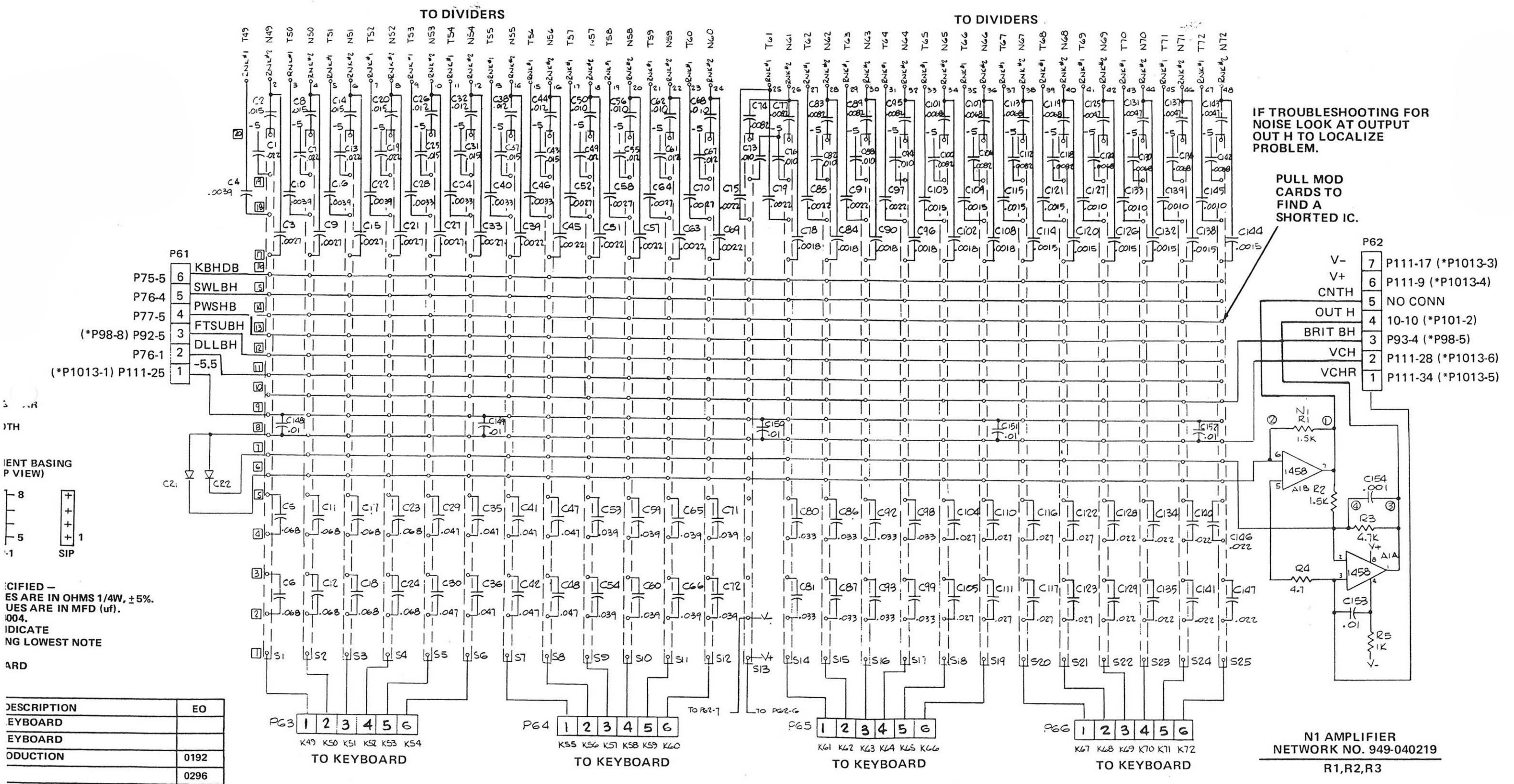
COMPONENT BASING
(TOP VIEW)


1
8
4
5
MC1458CP-1
SIP
1

NOTES:
UNLESS OTHERWISE SPECIFIED –
1. ALL RESISTOR VALUES ARE IN OHM
2. ALL CAPACITOR VALUES ARE IN MF
3. ALL DIODES ARE 1N4004.
4. N AND T SUFFIXES INDICATE
NOTE NUMBER, 1 BEING LOWEST NO
ON KEYBOARD.
5. * POLYMOOG KEYBOARD

REV	DESCRIPTION
A	REVISED FOR C-B KEYBOARD
B	REVISED FOR F-E KEYBOARD
C	RELEASED FOR PRODUCTION
D	UPDATE PER EO
E	NEXT ASS'Y WAS 981-040141

FER TO REPLACEMENT PARTS LIST IN
1, SECTION 3 FOR THE PART NUMBER AND
F EACH REFERENCE DESIGNATOR.


TO DIVIDERS
T49 N49 T50 N50 T51 N51 T52 N52 T53 N53 T54 N54 T55 N55 T56 N56 T57 N57 T58 N58 T59 N59 T60 N60
TO DIVIDERS
T61 N61 T62 N62 T63 N63 T64 N64 T65 N65 T66 N66 T67 N67 T68 N68 T69 N69 T70 N70 T71 N71 T72 N72
RNK#1 RNK#2
C2 .015 C8 .015 C14 .015 C20 .015 C26 .012 C32 .012 C38 .012 C44 .012 C50 .010 C56 .010 C62 .010 C68 .012
C74 C77 .0082 C83 .0082 C89 .0082 C95 .0068 C101 .0068 C107 .0068 C113 .0068 C119 .0068 C125 .0047 C131 .0047 C137 .0047 C143 .0047
-5
C4 .0039
C10 .0039 C16 .0039 C22 .0039 C28 .0033 C34 .0033 C40 .0033 C46 .0033 C52 .0027 C58 .0027 C64 .0027 C70 .0027
C3 .0027 C9 .0027 C15 .0027 C21 .0027 C27 .0027 C33 .0027 C39 .0022 C45 .0022 C51 .0022 C57 .0022 C63 .0022 C69 .0022
C18 .0018 C84 .0018 C90 .0018 C96 .0018 C102 .0018 C108 .0018 C114 .0015 C120 .0015 C126 .0015 C132 .0015 C138 .0015 C144 .0015
P61
KBHDB
SWLBH
PWSHB
FTSUBH
DLLBH
-5.5
P75-5 6
P76-4 5
P77-5 4
(*P98-8) P92-5 3
P76-1 2
(*P1013-1) P111-25 1
C148 .01 C149 .01 C150 .01 C151 .01 C152 .01
CR2
C5 .068 C11 .068 C17 .068 C23 .068 C29 .047 C35 .047 C41 .047 C47 .047 C53 .039 C59 .039 C65 .039 C71 .039
C80 .033 C86 .033 C92 .033 C98 .033 C104 .027 C110 .027 C116 .027 C122 .027 C128 .022 C134 .022 C140 .022 C146 .022
C6 .068 C12 .068 C18 .068 C24 .068 C30 .047 C36 .047 C42 .047 C48 .047 C54 .039 C60 .039 C66 .039 C72 .039
C81 .033 C87 .033 C93 .033 C99 .033 C105 .027 C111 .027 C117 .027 C123 .027 C129 .022 C135 .022 C141 .022 C147 .022
V-
V+
S1 S2 S3 S4 S5 S6 S7 S8 S9 S10 S11 S12 S13 S14 S15 S16 S17 S18 S19 S20 S21 S22 S23 S24 S25
TO P62-7
TO P62-6
P63 1 2 3 4 5 6
K49 K50 K51 K52 K53 K54
TO KEYBOARD
P64 1 2 3 4 5 6
K55 K56 K57 K58 K59 K60
TO KEYBOARD
P65 1 2 3 4 5 6
K61 K62 K63 K64 K65 K66
TO KEYBOARD
P66 1 2 3 4 5 6
K67 K68 K69 K70 K71 K72
TO KEYBOARD
P62
V- 7 P111-17 (*P1013-3)
V+ 6 P111-9 (*P1013-4)
CNTH 5 NO CONN
OUT H 4 10-10 (*P101-2)
BRIT BH 3 P93-4 (*P98-5)
VCH 2 P111-28 (*P1013-6)
VCHR 1 P111-34 (*P1013-5)
N1 R1 1.5K
②
①
1458 A1B
R2 1.5K
C154 .001
④
③
R3 4.7K
V+
A1A
1458
R4 4.7
C153 .01
R5 1K
V-
N1 AMPLIFIER
NETWORK NO. 949-040219
R1,R2,R3
8
5
1
SIP

IF TROUBLESHOOTING FOR NOISE LOOK AT OUTPUT OUT H TO LOCALIZE PROBLEM.

PULL MOD CARDS TO FIND A SHORTED IC.

S R

TH

IENT BASING
P VIEW)

CIFIED —
ES ARE IN OHMS 1/4W, ±5%.
UES ARE IN MFD (uf).
004.
IDICATE
NG LOWEST NOTE

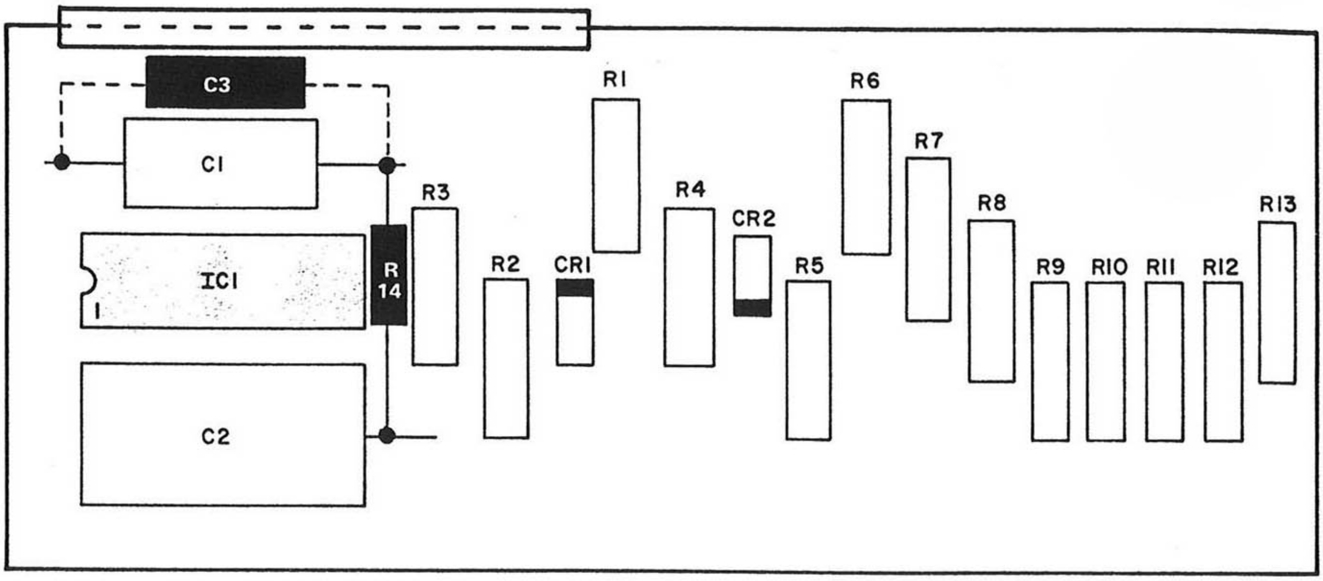
ARD

DESCRIPTION	EO
EYBOARD	
EYBOARD	
ODUCTION	0192
	0296
31-[illegible]141	0790

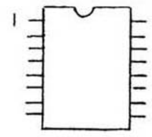
996-040145
MBH BOARD 6

HIGH MOTHER BOARD SCHEMATIC DIAGRAM MBH BOARD 6

NOTE:
REFER TO THE REPLACEMENT PARTS LIST IN VOLUME 1, SECTION 3 FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.



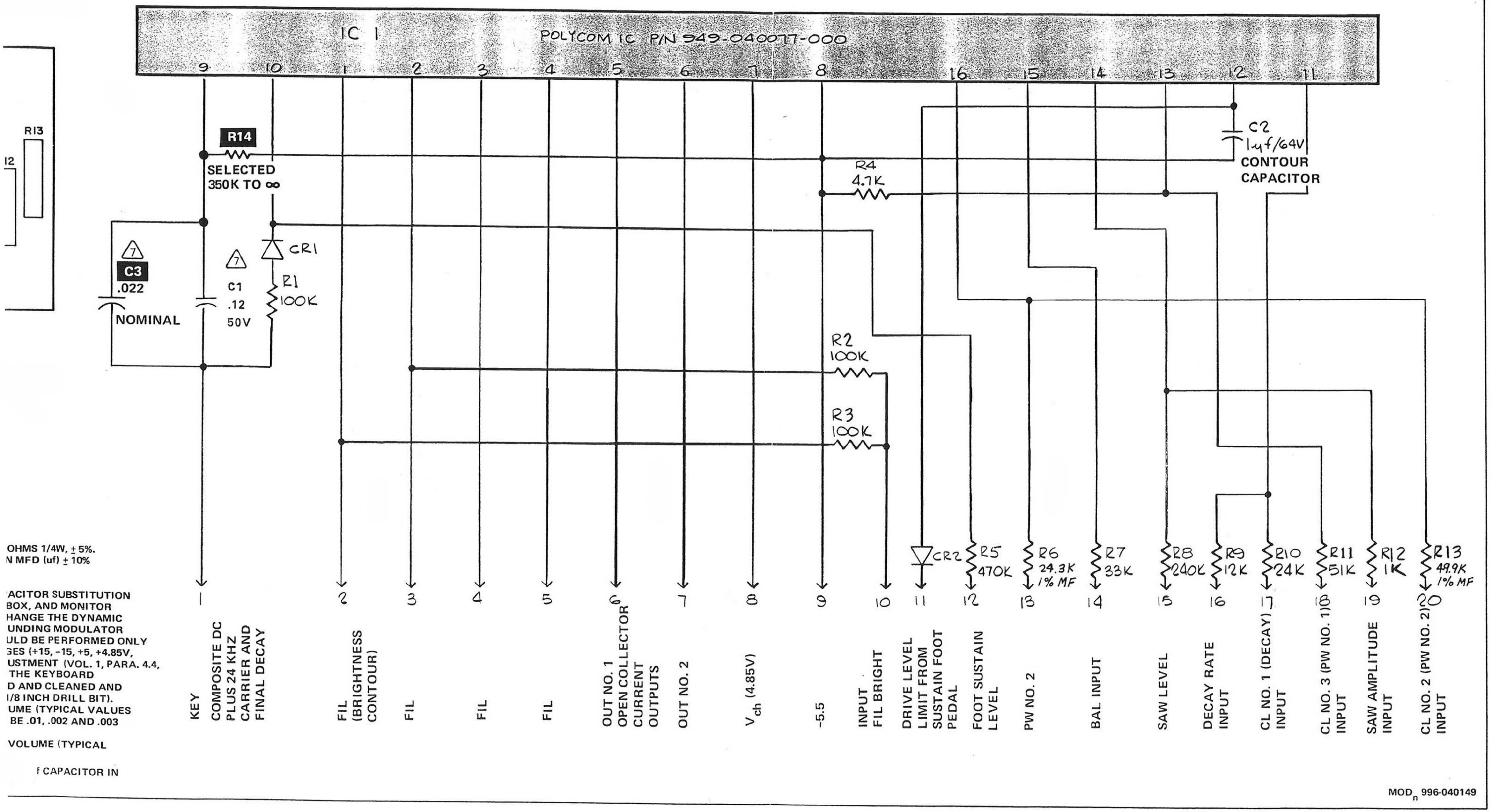
COMPONENT BASING
(TOP VIEW)



NOTES:
UNLESS OTHERWISE SPECIFIED.
1. ALL RESISTOR VALUES ARE IN OHMS 1/4W, ± 5%.
2. ALL CAPACITOR VALUES ARE IN MFD (uf) ± 10% METALLIZED MYLAR.
3. ALL DIODES 1N4148.
4. USING A DB METER, SCOPE, CAPACITOR SUBSTITUT
BOX, RESISTOR SUBSTITUTION BOX, AND MONITOR
AMPLIFIER IT IS POSSIBLE TO CHANGE THE DYNAM
RESPONSE OF LOW OR LOUD SOUNDING MODULAT
CARDS. THIS ADJUSTMENT SHOULD BE PERFORMED
AFTER PROPER SUPPLY VOLTAGES (+15, –15, +5, +4.
–5.5). KEYBOARD DYNAMIC ADJUSTMENT (VOL. 1, P
STEPS T, U AND V), AND AFTER THE KEYBOARD
CONTACTS HAVE BEEN CHECKED AND CLEANED AN
SPACED TO .120 GAGE INCHES (1/8 INCH DRILL BIT).
5. CAPACITOR C3 RAISES THE VOLUME (TYPICAL VAL
OF MYLAR CAPACITORS COULD BE .01, .002 AND .00
(uf) MAXIMUM.
6. RESISTOR R14 DECREASES THE VOLUME (TYPICAL VALUES: 330K TO ∞).
7. C1 AND C3 REPLACED WITH ONE .12uf CAPACITOR I
LATER PRODUCTION.

REV	DESCRIPTION	EO
A	ADDED 1K RESISTOR TO PIN 19	
B	RELEASED FOR PRODUCTION; ADDED (2) 1N4148 DIODES CR1 AND CR2	0192
C	CHANGED C1 FROM .1/100V METAL MYLAR TO .12/50V ± 5%	0663
D	NEXT ASSEMBLY WAS 981-040147	4790
E	CHANGED R6 FROM 24K, 5% TO 24.3K, 1% MF AND CHANGED R13 FROM 51K, 5% TO 49.9K, 1% MF.	0892

MODULATOR SCHEMATIC DIAGRAM MOD$_n$ CARD


IC 1
POLYCOM IC P/N 949-040077-000
9 10 1 2 3 4 5 6 7 8 16 15 14 13 12 11
R13
12
R14
SELECTED
350K TO ∞
C3
.022
NOMINAL
C1
.12
50V
CR1
R1
100K
R2
100K
R3
100K
R4
4.7K
C2
1μf/64V
CONTOUR
CAPACITOR
CR2
R5 470K
R6 24.3K 1% MF
R7 33K
R8 240K
R9 12K
R10 24K
R11 51K
R12 1K
R13 49.9K 1% MF
1 KEY
COMPOSITE DC PLUS 24 KHZ CARRIER AND FINAL DECAY
2 FIL (BRIGHTNESS CONTOUR)
3 FIL
4 FIL
5 FIL
6 OUT NO. 1 OPEN COLLECTOR CURRENT OUTPUTS
7 OUT NO. 2
8 V_{ch} (4.85V)
9 -5.5
10 INPUT FIL BRIGHT
11 DRIVE LEVEL LIMIT FROM SUSTAIN FOOT PEDAL
12 FOOT SUSTAIN LEVEL
13 PW NO. 2
14 BAL INPUT
15 SAW LEVEL
16 DECAY RATE INPUT
17 CL NO. 1 (DECAY) INPUT
18 CL NO. 3 (PW NO. 1) INPUT
19 SAW AMPLITUDE INPUT
20 CL NO. 2 (PW NO. 2) INPUT
MOD$_n$ 996-040149

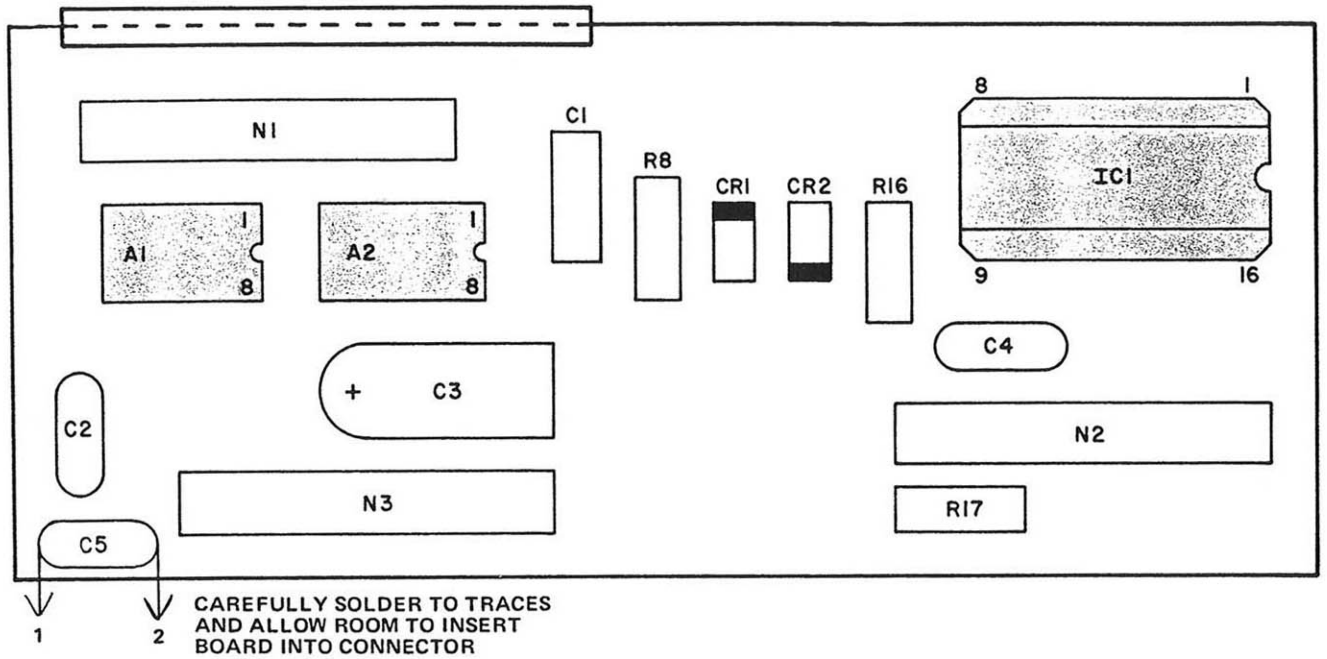
OHMS 1/4W, ± 5%.
N MFD (uf) ± 10%

'ACITOR SUBSTITUTION
BOX, AND MONITOR
HANGE THE DYNAMIC
UNDING MODULATOR
ULD BE PERFORMED ONLY
GES (+15, -15, +5, +4.85V,
USTMENT (VOL. 1, PARA. 4.4,
THE KEYBOARD
D AND CLEANED AND
I/8 INCH DRILL BIT).
UME (TYPICAL VALUES
BE .01, .002 AND .003

VOLUME (TYPICAL

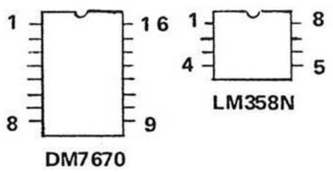
f CAPACITOR IN

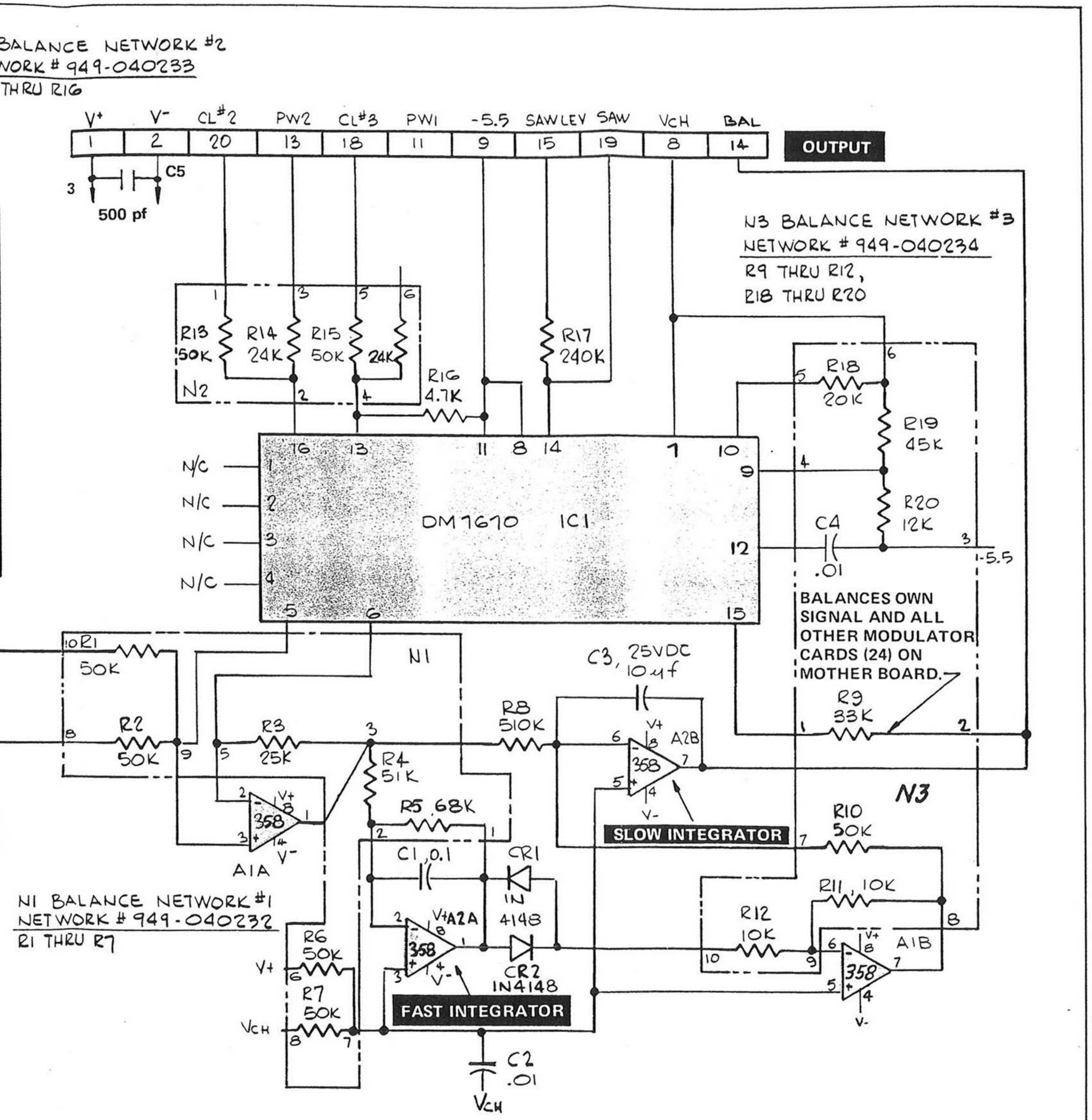
NOTE: REFER TO THE REPLACEMENT PARTS LIST IN VOLUME 1, SECTION 3 FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.


N1
C1
R8
CR1
CR2
R16
8
1
IC1
9
16
A1
1
8
A2
1
8
C4
+
C3
C2
N2
N3
R17
C5
1
2

CAREFULLY SOLDER TO TRACES AND ALLOW ROOM TO INSERT BOARD INTO CONNECTOR

COMPONENT BASING
(TOP VIEW)


1
16
8
9
DM7670
1
8
4
5
LM358N

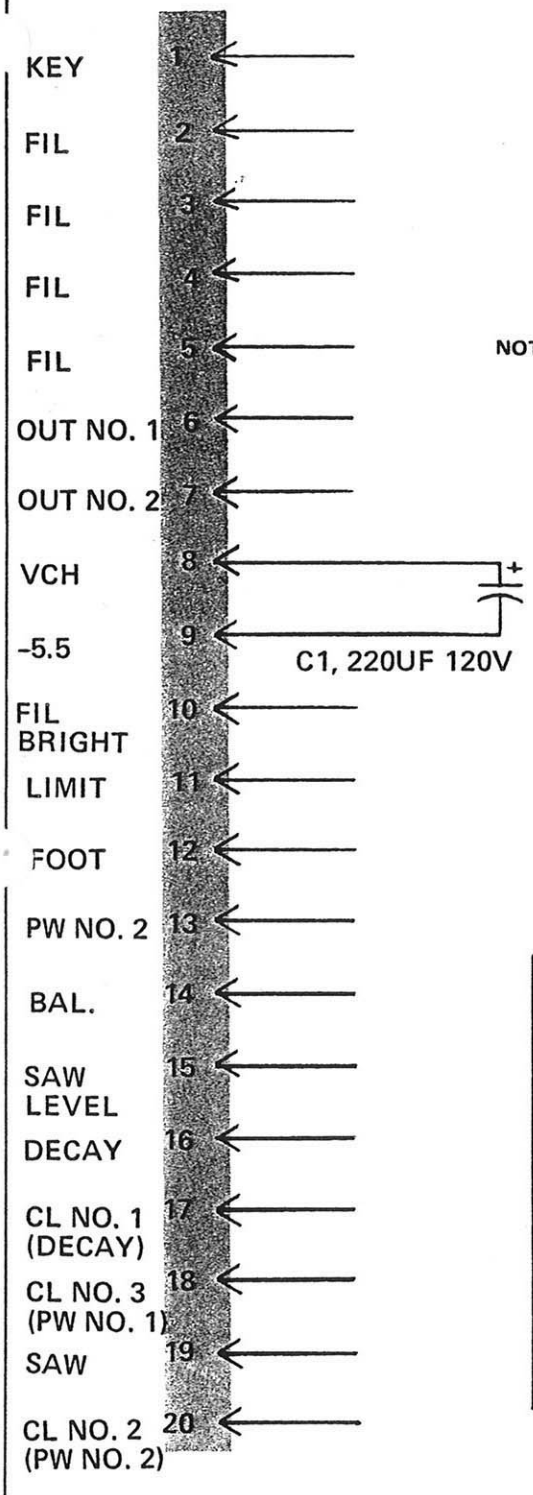

N2 BALANCE NETWORK #2
NETWORK # 949-040233
R13 THRU R16
V+
V-
CL#2
PW2
CL#3
PW1
-5.5
SAW LEV
SAW
VCH
BAL
1
2
20
13
18
11
9
15
19
8
14
OUTPUT
3
C5
500 pf
N3 BALANCE NETWORK #3
NETWORK # 949-040234
R9 THRU R12,
R18 THRU R20
R13 50K
R14 24K
R15 50K
24K
N2
R16 4.7K
R17 240K
R18 20K
R19 45K
R20 12K
C4 .01
-5.5
N/C
N/C
N/C
N/C
DM7670 IC1
BALANCES OWN SIGNAL AND ALL OTHER MODULATOR CARDS (24) ON MOTHER BOARD.
R9 33K
V+
R1 50K
VCH
R2 50K
R3 25K
R4 51K
R5 68K
N1
C3, 25VDC 10uf
R8 510K
A2B
358
SLOW INTEGRATOR
N3
R10 50K
R11 10K
R12 10K
A1B
358
A1A
358
C1 0.1
CR1 IN 4148
A2A
358
CR2 IN4148
FAST INTEGRATOR
C2 .01
VCH
N1 BALANCE NETWORK #1
NETWORK # 949-040232
R1 THRU R7
V+
R6 50K
R7 50K
VCH

NOTES:
UNLESS OTHERWISE SPECIFIED.
1. ALL RESISTOR VALUES ARE IN OHMS 1/4W, ±5%.
2. ALL CAPACITOR VALUES ARE IN MFD (uf).
3. CERAMIC DISC CAPACITOR ADDED TO REDUCE PARASITICS.

REV	DESCRIPTION	EO
A	RELEASED FOR PRODUCTION	0192
B	NEXT ASS'Y WAS 981-040155	0790
C	ADDED C5 500PF	823

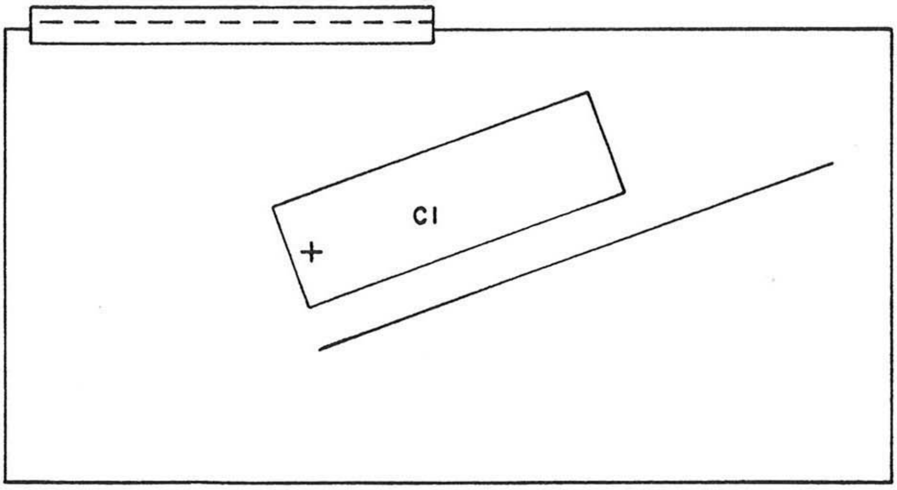
BAL 996-040157

BALANCE CARD SCHEMATIC DIAGRAM


KEY 1
FIL 2
FIL 3
FIL 4
FIL 5
OUT NO. 1 6
OUT NO. 2 7
VCH 8
-5.5 9
FIL BRIGHT 10
LIMIT 11
FOOT 12
PW NO. 2 13
BAL. 14
SAW LEVEL 15
DECAY 16
CL NO. 1 (DECAY) 17
CL NO. 3 (PW NO. 1) 18
SAW 19
CL NO. 2 (PW NO. 2) 20
+
C1, 220UF 120V

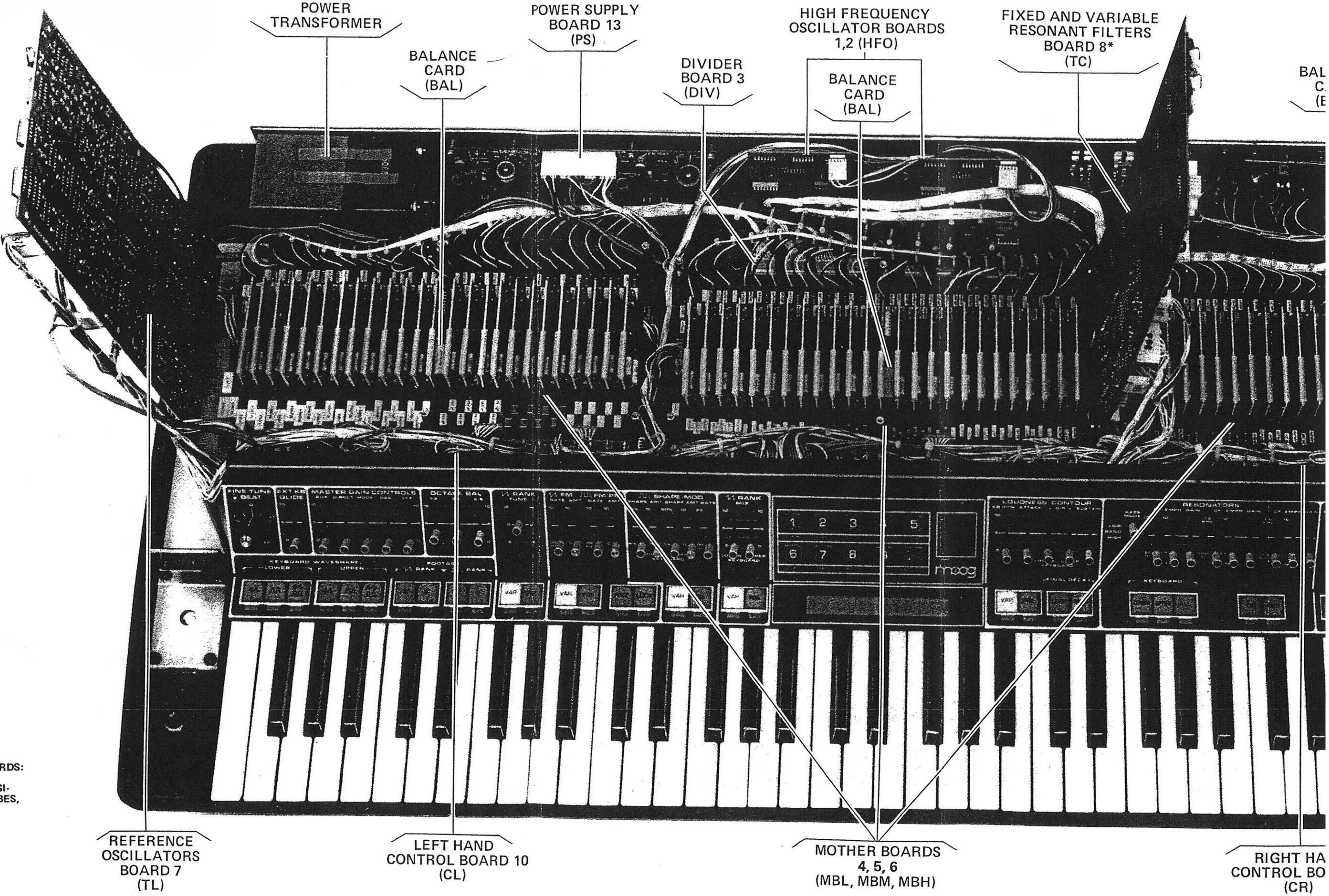
REV	DESCRIPTION	EO
	RELEASED FOR PRODUCTION	0233

NOTE: REFER TO THE REPLACEMENT PARTS LIST IN VOLUME 1, SECTION 3 FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.

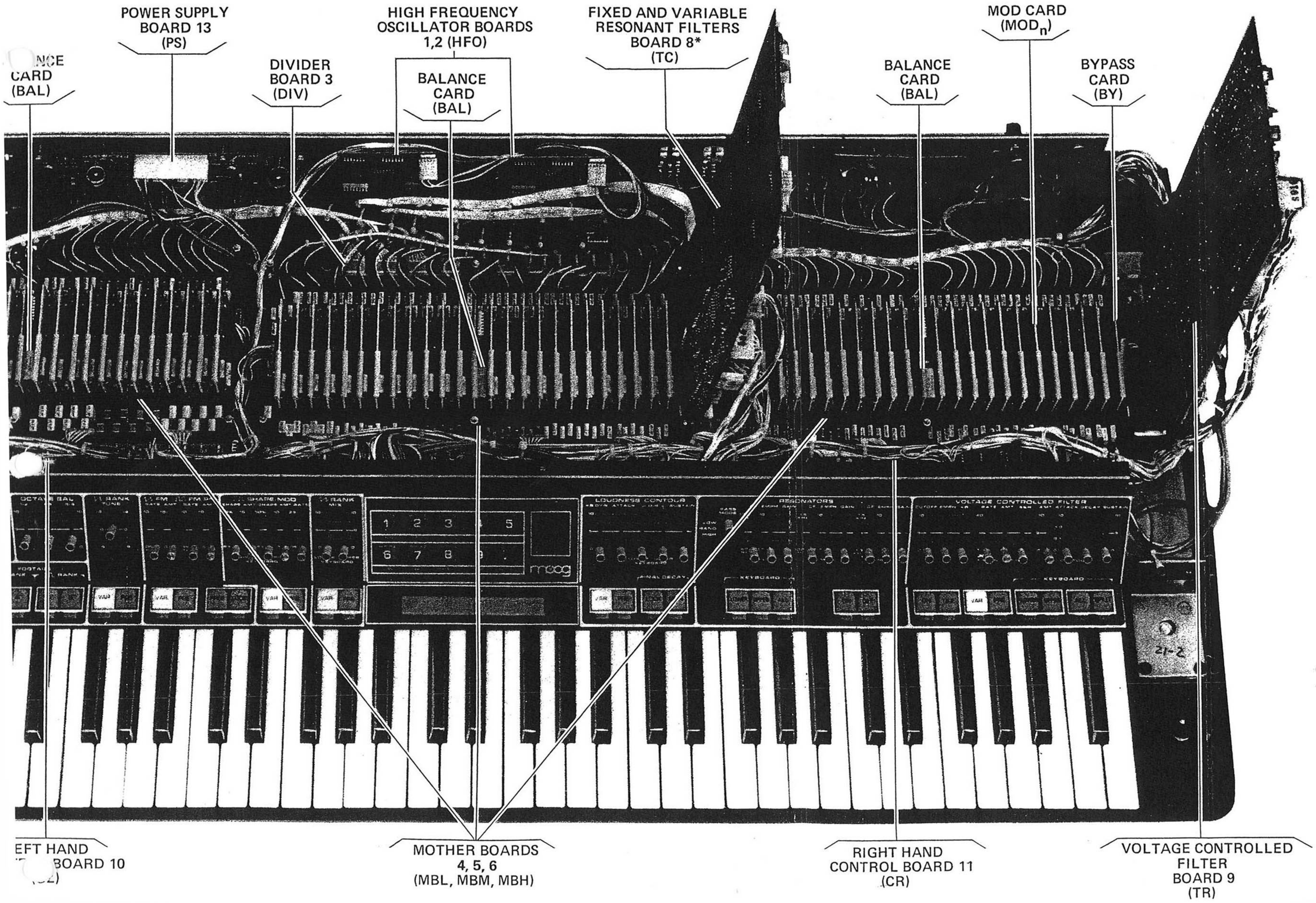


BY 996-040635

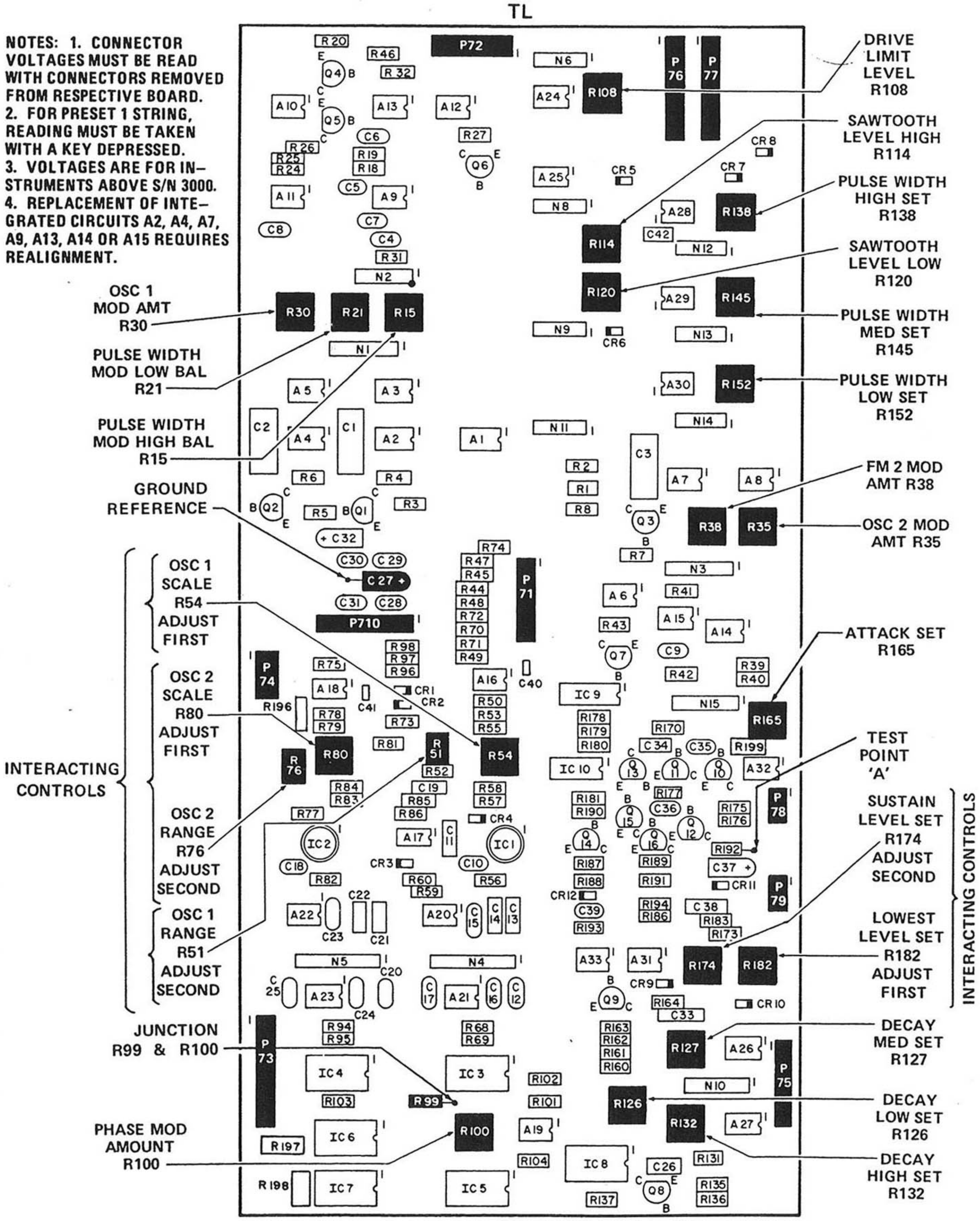
BYPASS CARD SCHEMATIC DIAGRAM

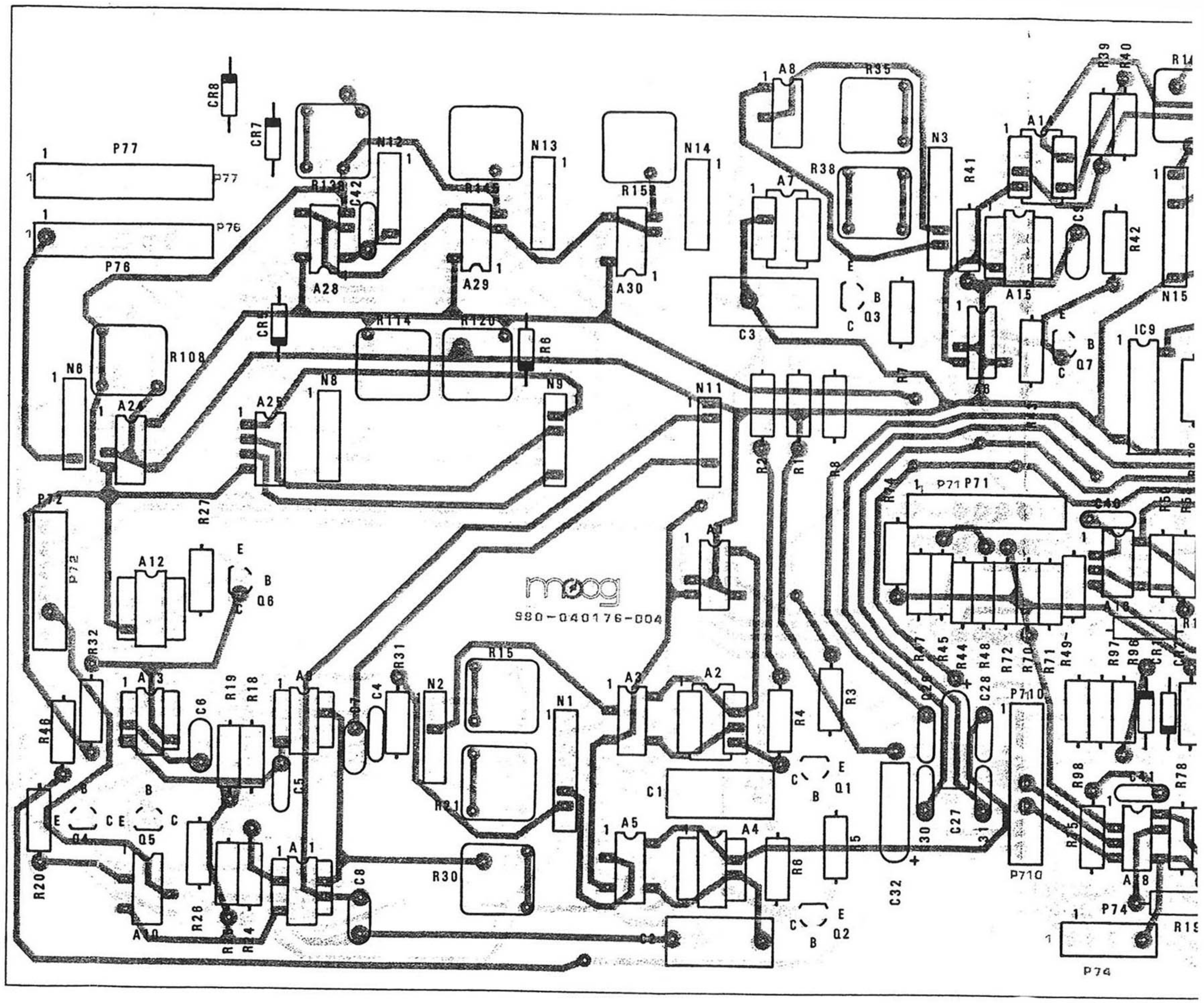

POWER TRANSFORMER
BALANCE CARD (BAL)
POWER SUPPLY BOARD 13 (PS)
DIVIDER BOARD 3 (DIV)
HIGH FREQUENCY OSCILLATOR BOARDS 1,2 (HFO)
BALANCE CARD (BAL)
FIXED AND VARIABLE RESONANT FILTERS BOARD 8* (TC)
BAL
C
(E
REFERENCE OSCILLATORS BOARD 7 (TL)
LEFT HAND CONTROL BOARD 10 (CL)
MOTHER BOARDS 4, 5, 6 (MBL, MBM, MBH)
RIGHT HA
CONTROL BO
(CR)
moog

* BOARD 8 CONTAINS 8 FILTER BOARDS: BOARD 1 STRING FILTER, 2 PIANO FILTER, 3 ORGAN FILTER, 4 HARPSICHORD, 5 FUNK, 6 CLAVINET, 7 VIBES, 8 MODE FOR BRASS.


NCE
CARD
(BAL)
POWER SUPPLY
BOARD 13
(PS)
DIVIDER
BOARD 3
(DIV)
HIGH FREQUENCY
OSCILLATOR BOARDS
1,2 (HFO)
BALANCE
CARD
(BAL)
FIXED AND VARIABLE
RESONANT FILTERS
BOARD 8*
(TC)
BALANCE
CARD
(BAL)
MOD CARD
(MOD$_n$)
BYPASS
CARD
(BY)
EFT HAND
BOARD 10
MOTHER BOARDS
4, 5, 6
(MBL, MBM, MBH)
RIGHT HAND
CONTROL BOARD 11
(CR)
VOLTAGE CONTROLLED
FILTER
BOARD 9
(TR)
moog
21-2

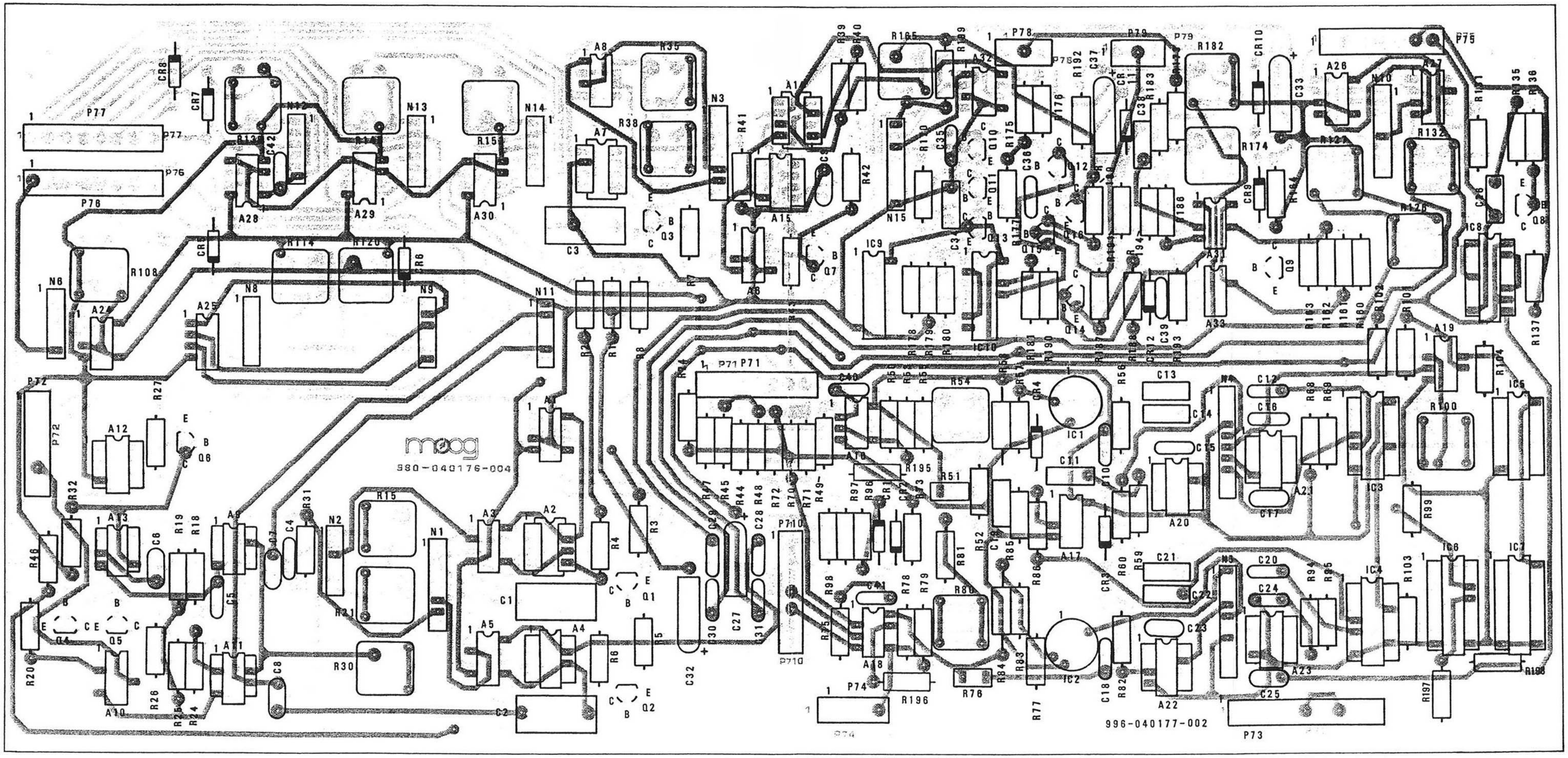
NOTES: 1. CONNECTOR VOLTAGES MUST BE READ WITH CONNECTORS REMOVED FROM RESPECTIVE BOARD.
2. FOR PRESET 1 STRING, READING MUST BE TAKEN WITH A KEY DEPRESSED.
3. VOLTAGES ARE FOR INSTRUMENTS ABOVE S/N 3000.
4. REPLACEMENT OF INTEGRATED CIRCUITS A2, A4, A7, A9, A13, A14 OR A15 REQUIRES REALIGNMENT.


TL
OSC 1 MOD AMT R30
PULSE WIDTH MOD LOW BAL R21
PULSE WIDTH MOD HIGH BAL R15
GROUND REFERENCE
INTERACTING CONTROLS
OSC 1 SCALE R54 ADJUST FIRST
OSC 2 SCALE R80 ADJUST FIRST
OSC 2 RANGE R76 ADJUST SECOND
OSC 1 RANGE R51 ADJUST SECOND
JUNCTION R99 & R100
PHASE MOD AMOUNT R100
DRIVE LIMIT LEVEL R108
SAWTOOTH LEVEL HIGH R114
PULSE WIDTH HIGH SET R138
SAWTOOTH LEVEL LOW R120
PULSE WIDTH MED SET R145
PULSE WIDTH LOW SET R152
FM 2 MOD AMT R38
OSC 2 MOD AMT R35
ATTACK SET R165
TEST POINT 'A'
SUSTAIN LEVEL SET R174 ADJUST SECOND
LOWEST LEVEL SET R182 ADJUST FIRST
INTERACTING CONTROLS
DECAY MED SET R127
DECAY LOW SET R126
DECAY HIGH SET R132


moog
980-040176-004
P77
P76
P72
P710
P74

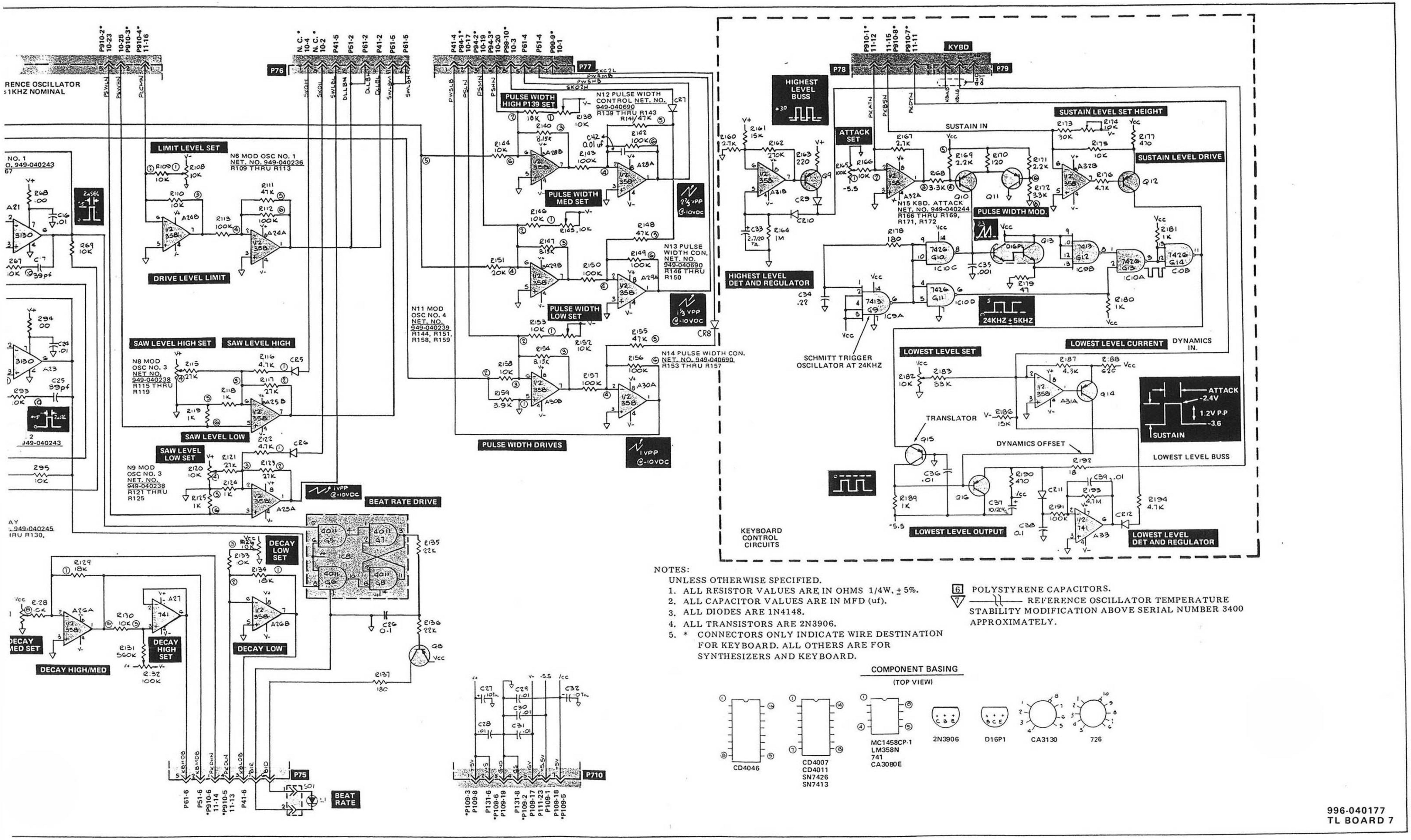
REFERENCE AND MODULATION WAVESHAPE AND KEYBOARD CONTROL PRINTED CIRCUIT TL BOARD 7 ASSEMBLY

INTERACTING CONTROLS


moog
980-040176-004
996-040177-002
P77
P76
P72
P71
P73
P74
P75
P78
P79
P710
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC8
IC9
IC10

996-040177
TL BOARD 7

IBLY


REFERENCE OSCILLATOR
1KHZ NOMINAL
P76
P77
P78
P79
KYBD
LIMIT LEVEL SET
DRIVE LEVEL LIMIT
N6 MOD OSC NO. 1
NET. NO. 949-040236
R109 THRU R113
PULSE WIDTH HIGH P139 SET
N12 PULSE WIDTH CONTROL NET. NO. 949-040690
R139 THRU R143
PULSE WIDTH MED SET
N13 PULSE WIDTH CON. NET. NO. 949-040690
R146 THRU R150
PULSE WIDTH LOW SET
N11 MOD OSC NO. 4
NET. NO. 949-040239
R144, R151, R158, R159
N14 PULSE WIDTH CON. NET. NO. 949-040690
R153 THRU R157
PULSE WIDTH DRIVES
SAW LEVEL HIGH SET
SAW LEVEL HIGH
N8 MOD OSC NO. 3
NET. NO. 949-040238
R115 THRU R119
SAW LEVEL LOW
SAW LEVEL LOW SET
N9 MOD OSC NO. 3
NET. NO. 949-040238
R121 THRU R125
BEAT RATE DRIVE
DECAY LOW SET
DECAY LOW
DECAY MED SET
DECAY HIGH SET
DECAY HIGH/MED
P75
BEAT RATE
P710
HIGHEST LEVEL BUSS
ATTACK SET
N15 KBD. ATTACK NET. NO. 949-040244
R166 THRU R169, R171, R172
SUSTAIN IN
SUSTAIN LEVEL SET HEIGHT
SUSTAIN LEVEL DRIVE
PULSE WIDTH MOD.
HIGHEST LEVEL DET AND REGULATOR
SCHMITT TRIGGER OSCILLATOR AT 24KHZ
24KHZ ± 5KHZ
LOWEST LEVEL SET
LOWEST LEVEL CURRENT
DYNAMICS IN.
TRANSLATOR
DYNAMICS OFFSET
ATTACK -2.4V
1.2V P.P
-3.6
SUSTAIN
LOWEST LEVEL BUSS
LOWEST LEVEL OUTPUT
LOWEST LEVEL DET AND REGULATOR
KEYBOARD CONTROL CIRCUITS
COMPONENT BASING
(TOP VIEW)
CD4046
CD4007
CD4011
SN7426
SN7413
MC1458CP-1
LM358N
741
CA3080E
2N3906
D16P1
CA3130
726

NOTES:
UNLESS OTHERWISE SPECIFIED.
1. ALL RESISTOR VALUES ARE IN OHMS 1/4W, ± 5%.
2. ALL CAPACITOR VALUES ARE IN MFD (uf).
3. ALL DIODES ARE 1N4148.
4. ALL TRANSISTORS ARE 2N3906.
5. * CONNECTORS ONLY INDICATE WIRE DESTINATION FOR KEYBOARD. ALL OTHERS ARE FOR SYNTHESIZERS AND KEYBOARD.

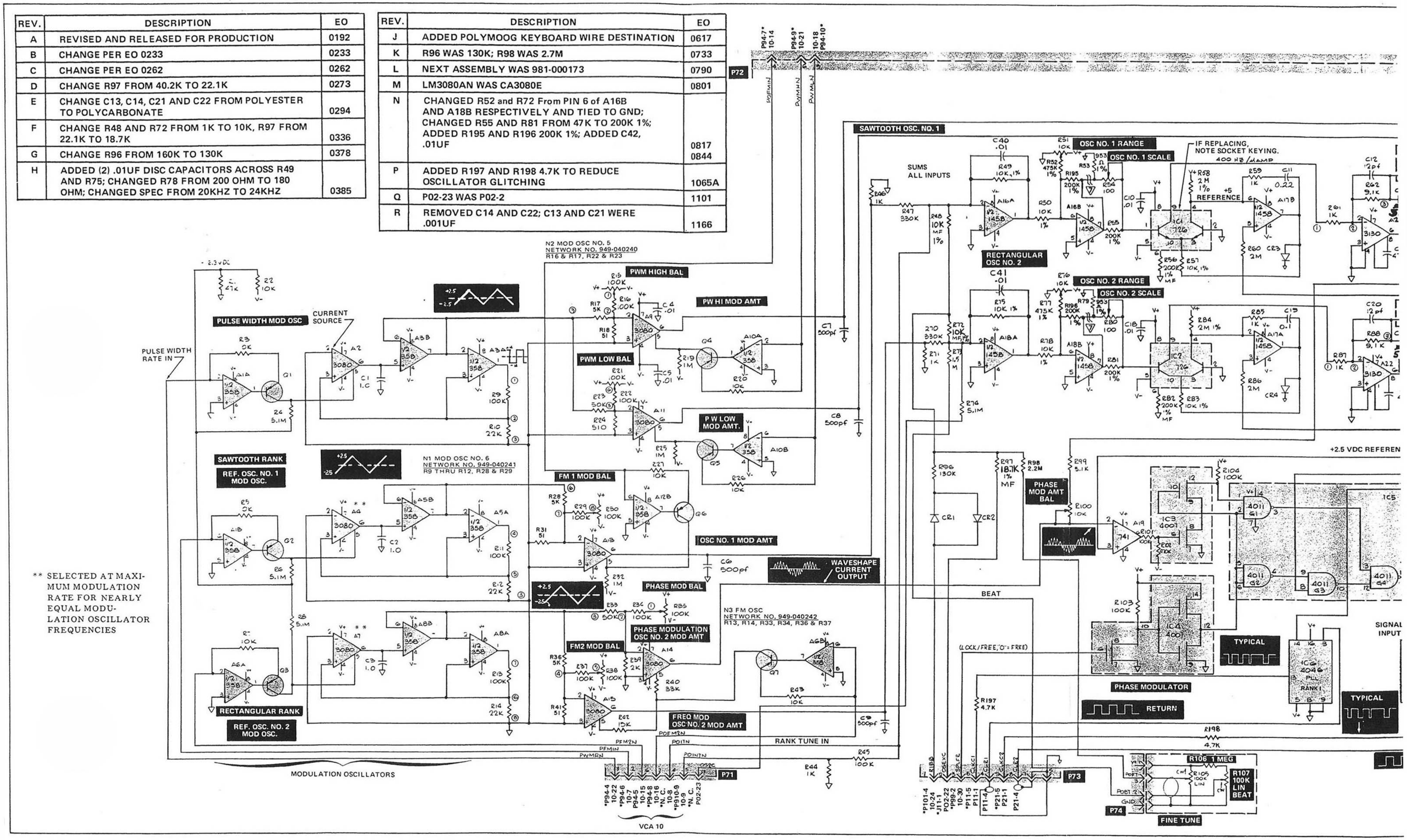
⑥ POLYSTYRENE CAPACITORS.
⑦ ——||—— REFERENCE OSCILLATOR TEMPERATURE STABILITY MODIFICATION ABOVE SERIAL NUMBER 3400 APPROXIMATELY.

996-040177
TL BOARD 7

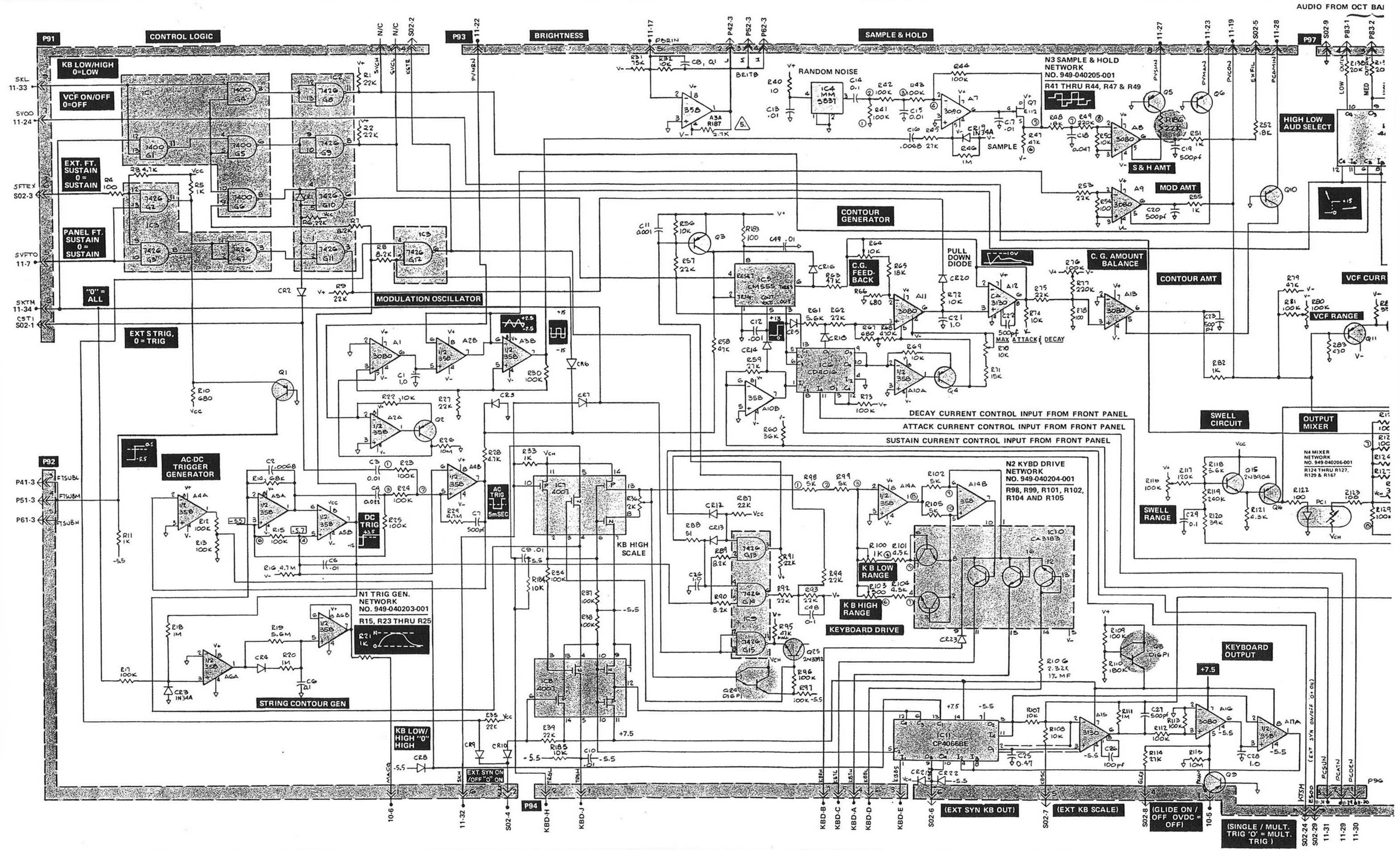
REFERENCE AND MODULATION WAVESHAPE AND KEYBOARD CONTROL PRINTED CIRCUIT TL BOARD 7 ASSEMBLY

REV.	DESCRIPTION	EO
A	REVISED AND RELEASED FOR PRODUCTION	0192
B	CHANGE PER EO 0233	0233
C	CHANGE PER EO 0262	0262
D	CHANGE R97 FROM 40.2K TO 22.1K	0273
E	CHANGE C13, C14, C21 AND C22 FROM POLYESTER TO POLYCARBONATE	0294
F	CHANGE R48 AND R72 FROM 1K TO 10K, R97 FROM 22.1K TO 18.7K	0336
G	CHANGE R96 FROM 160K TO 130K	0378
H	ADDED (2) .01UF DISC CAPACITORS ACROSS R49 AND R75; CHANGED R78 FROM 200 OHM TO 180 OHM; CHANGED SPEC FROM 20KHZ TO 24KHZ	0385

REV.	DESCRIPTION	EO
J	ADDED POLYMOOG KEYBOARD WIRE DESTINATION	0617
K	R96 WAS 130K; R98 WAS 2.7M	0733
L	NEXT ASSEMBLY WAS 981-000173	0790
M	LM3080AN WAS CA3080E	0801
N	CHANGED R52 and R72 From PIN 6 of A16B AND A18B RESPECTIVELY AND TIED TO GND; CHANGED R55 AND R81 FROM 47K TO 200K 1%; ADDED R195 AND R196 200K 1%; ADDED C42, .01UF	0817 0844
P	ADDED R197 AND R198 4.7K TO REDUCE OSCILLATOR GLITCHING	1065A
Q	P02-23 WAS P02-2	1101
R	REMOVED C14 AND C22; C13 AND C21 WERE .001UF	1166


P72
P94-7* 10-14
P94-9* 10-21
10-18 P94-10*
PWMLN
PWMHN
POFMIN
SAWTOOTH OSC. NO. 1
SUMS ALL INPUTS
OSC NO. 1 RANGE
OSC NO. 1 SCALE
IF REPLACING, NOTE SOCKET KEYING. 400 HZ/MAMP
+5 REFERENCE
RECTANGULAR OSC NO. 2
OSC NO. 2 RANGE
OSC NO. 2 SCALE
N2 MOD OSC NO. 5
NETWORK NO. 949-040240
R16 & R17, R22 & R23
PWM HIGH BAL
PW HI MOD AMT
PWM LOW BAL
P W LOW MOD AMT.
PULSE WIDTH MOD OSC
CURRENT SOURCE
PULSE WIDTH RATE IN
SAWTOOTH RANK
REF. OSC. NO. 1 MOD OSC.
N1 MOD OSC NO. 6
NETWORK NO. 949-040241
R9 THRU R12, R28 & R29
FM 1 MOD BAL
OSC NO. 1 MOD AMT
WAVESHAPE CURRENT OUTPUT
PHASE MOD BAL
N3 FM OSC
NETWORK NO. 949-040242
R13, R14, R33, R34, R36 & R37
PHASE MODULATION OSC NO. 2 MOD AMT
FM2 MOD BAL
FREQ MOD OSC NO. 2 MOD AMT
RECTANGULAR RANK
REF. OSC. NO. 2 MOD OSC.
RANK TUNE IN
MODULATION OSCILLATORS
P71
*P94-4 10-22 *P94-6 10-7 P94-5 10-15 *P94-8 10-16 *N.C. 10-8 *P910-9 10-9 *N.C. P02-23
VCA 10
PHASE MOD AMT BAL
BEAT
(LOCK/FREE, "0" = FREE)
PHASE MODULATOR
RETURN
TYPICAL
+2.5 VDC REFERENCE
SIGNAL INPUT
IC6 4046 PLL RANK 1
IC3 4001
IC4 4001
IC5
4011 G1
4011 G2
4011 G3
4011 G4
P73
*P101-4 10-24 *J11-1 P02-22 *P99-2 10-30 *P11-5 *P11-1 P11-4 *P21-5 P21-1 P21-4
P74
R106 1 MEG
R107 100K LIN BEAT
FINE TUNE
A1A A2 A3A A3B A4 A5A A5B A6A A7 A8A A8B A9 A10A A10B A11 A12B A13 A14 A15 A16A A16B A17A A17B A18A A18B A19 A21 A22
3080 358 1458 741 726 3130
Q1 Q2 Q3 Q4 Q5 Q6 Q7
CR1 CR2 CR3 CR4
IC1 726 IC2 726

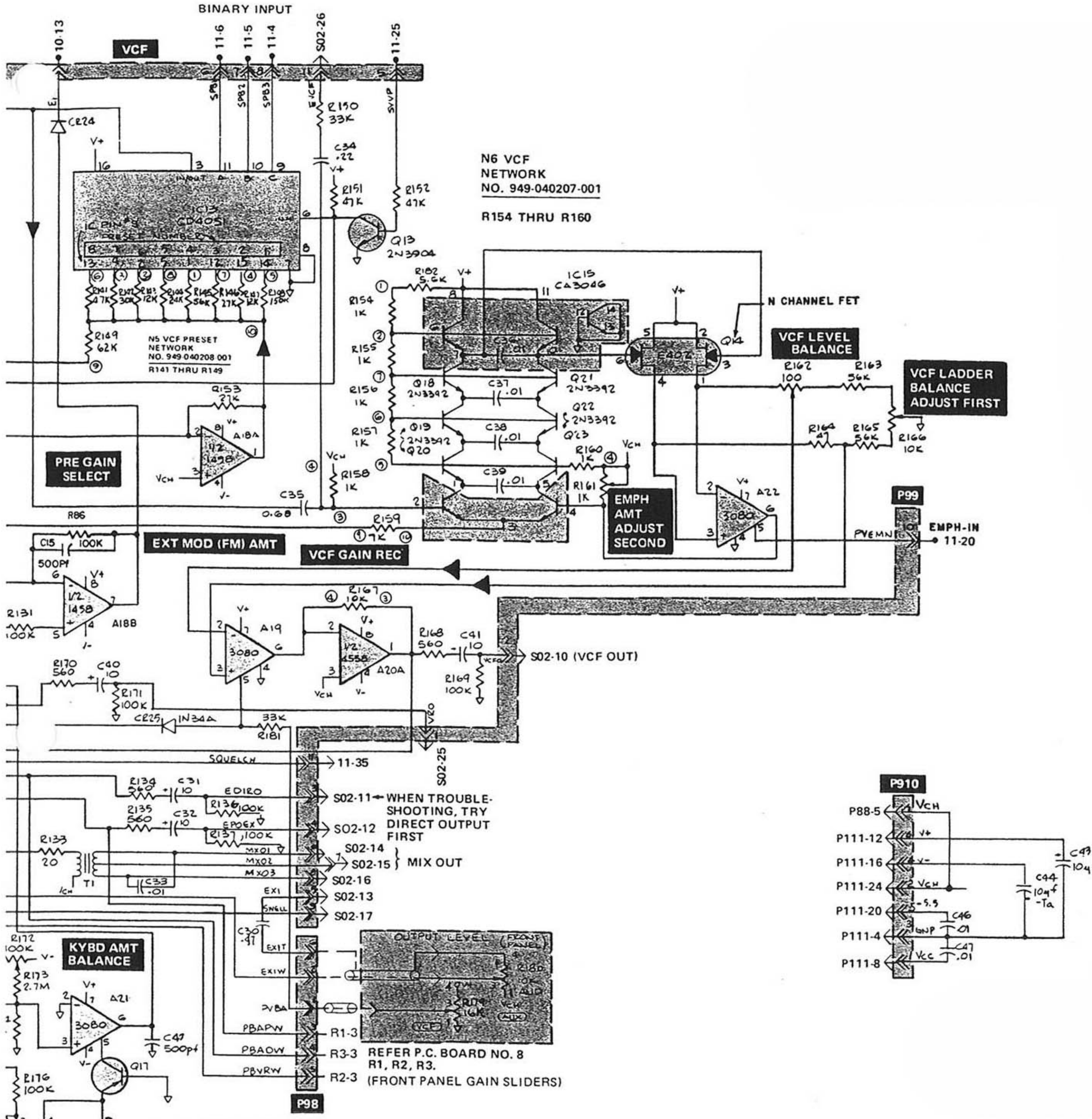
** SELECTED AT MAXIMUM MODULATION RATE FOR NEARLY EQUAL MODULATION OSCILLATOR FREQUENCIES

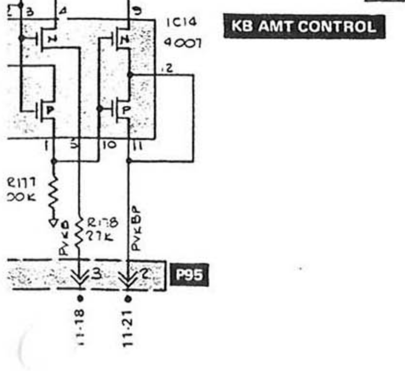

AUDIO FROM OCT BA
CONTROL LOGIC
BRIGHTNESS
SAMPLE & HOLD
P91
P92
P93
P94
P96
P97
KB LOW/HIGH 0=LOW
VCF ON/OFF 0=OFF
EXT. FT. SUSTAIN 0 = SUSTAIN
PANEL FT. SUSTAIN 0 = SUSTAIN
"0" = ALL
EXT S TRIG, 0 = TRIG
MODULATION OSCILLATOR
AC-DC TRIGGER GENERATOR
DC TRIG
AC TRIG 5mSEC
N1 TRIG GEN. NETWORK NO. 949-040203-001 R15, R23 THRU R25
STRING CONTOUR GEN
KB LOW/HIGH "0" HIGH
EXT. SYN ON /OFF "0" ON
KB HIGH SCALE
RANDOM NOISE
N3 SAMPLE & HOLD NETWORK NO. 949-040205-001 R41 THRU R44, R47 & R49
SAMPLE
S & H AMT
MOD AMT
HIGH LOW AUD SELECT
CONTOUR GENERATOR
C.G. FEED-BACK
PULL DOWN DIODE
C. G. AMOUNT BALANCE
MAX ATTACK DECAY
CONTOUR AMT
VCF CURR
VCF RANGE
DECAY CURRENT CONTROL INPUT FROM FRONT PANEL
ATTACK CURRENT CONTROL INPUT FROM FRONT PANEL
SUSTAIN CURRENT CONTROL INPUT FROM FRONT PANEL
N2 KYBD DRIVE NETWORK NO. 949-040204-001 R98, R99, R101, R102, R104 AND R105
K B LOW RANGE
K B HIGH RANGE
KEYBOARD DRIVE
SWELL CIRCUIT
SWELL RANGE
OUTPUT MIXER
N4 MIXER NETWORK NO. 949-040206-001 R124 THRU R127, R129 & R167
KEYBOARD OUTPUT
+7.5
(EXT SYN KB OUT)
(EXT KB SCALE)
(GLIDE ON / OFF 0VDC = OFF)
(SINGLE / MULT. TRIG '0' = MULT. TRIG)
SKL 11-33
SVOO 11-24
SFTEX S02-3
SVFTO 11-7
SKTM 11-34
CSTI S02-1
P41-3
P51-3
P61-3
10-6
11-32
S02-4
KBD-H
KBD-J
KBD-B
KBD-C
KBD-A
KBD-D
KBD-E
S02-6
S02-7
S02-8
10-5
S02-24
S02-29
11-31
11-29
11-30
N/C
S02-2
11-22
11-17
P42-3
P52-3
P62-3
11-27
11-23
11-19
S02-5
11-28
S02-9
P83-1
P83-2
IC1 7400
IC2 7426
IC3 7426
IC4 MM 5837
IC5 LM555
IC6 CD4016
IC7 4007
IC8 4007
IC9 7426
IC10 CA3183
IC11 CP4066BE

'OLTAGE CONTROLLED FILTER AND KEYBOARD CIRCUIT PRINTED CIRCUIT TR BOARD 9 ASSEMBLY

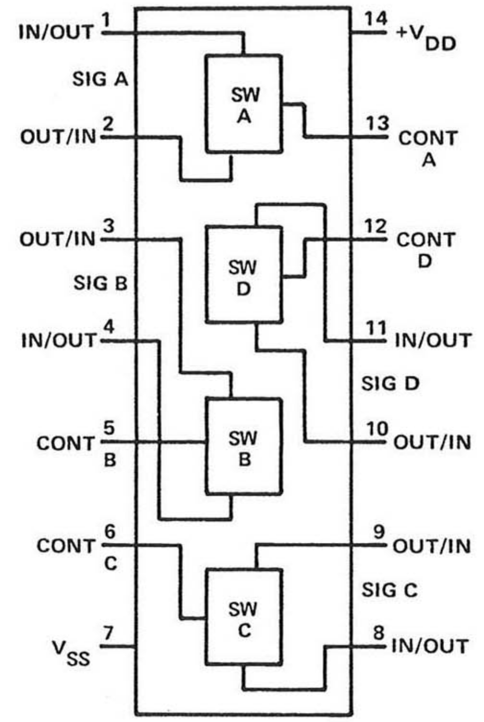
8

1	2	3	4	5	9
6	7	8	9	•	

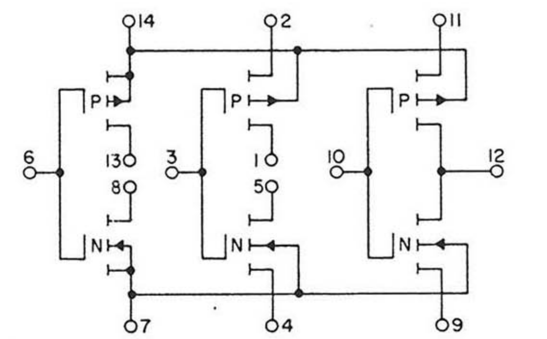

BINARY INPUT
VCF
10-13
11-6
11-5
11-4
S02-26
11-25
SPB1
SPB2
SPB3
SVVP
CR24
V+
R150 33K
C34 .22
R151 47K
R152 47K
IC13 CD4051
Q13 2N3904
N6 VCF NETWORK NO. 949-040207-001
R154 THRU R160
N5 VCF PRESET NETWORK NO. 949-040208-001
R141 THRU R149
R169 62K
R153 27K
PRE GAIN SELECT
1/2 1458
A18A
VCH
R162 5.6K
IC15 CA3046
R154 1K
R155 1K
R156 1K
R157 1K
R158 1K
Q18 2N3392
Q19 2N3392
Q20
Q21 2N3392
Q22 2N3392
Q23
C37 .01
C38 .01
C39 .01
N CHANNEL FET
Q14
E402
VCF LEVEL BALANCE
R162 100
R163 56K
VCF LADDER BALANCE ADJUST FIRST
R164 47
R165 56K
R166 10K
R160 1K
R161 1K
EMPH AMT ADJUST SECOND
A22
3080
C35 0.68
R159 7K
R86
C15 500pf
100K
EXT MOD (FM) AMT
VCF GAIN REC
P99
PVEMN
EMPH-IN 11-20
R131 100K
1/2 1458
A18B
R167 10K
A19
3080
1/2 4558
A20A
R168 560
C41 10
R169 100K
S02-10 (VCF OUT)
R170 560
C40 10
R171 100K
CR25
1N34A
33K
R181
SQUELCH
11-35
S02-25
R134
C31 10
R135 560
C32 10
R136 100K
R137 100K
EDIRO
EP06X
MX01
MX02
MX03
S02-11
WHEN TROUBLE-SHOOTING, TRY DIRECT OUTPUT FIRST
S02-12
S02-14
S02-15
MIX OUT
S02-16
S02-13
S02-17
R133 20
T1
C33 .01
EX1
SWELL
C30 .47
EXIT
EXIW
PVBA
PBAPW
PBAOW
PBVRW
OUTPUT LEVEL (FRONT PANEL)
R174 10K
R1-3
R3-3
R2-3
REFER P.C. BOARD NO. 8 R1, R2, R3. (FRONT PANEL GAIN SLIDERS)
P98
R172 100K
KYBD AMT BALANCE
R173 2.7M
A21
3080
C47 500pf
Q17
R176 100K
P910
P88-5
P111-12
P111-16
P111-24
P111-20
P111-4
P111-8
VCH
V+
V-
-5.5
GNP
VCC
C43 10uf -Ta
C44 10uf -Ta
C46 .01
C47 .01


KB AMT CONTROL
IC14 4007
R177 100K
R178 27K
PVKB
PVKBP
P95
11-18
11-21

REV	DESCRIPTION	EO
A	REVISED AND REDRAWN. RELEASED FOR PRODUCTION	0192
B	REVISED PER EO 0233	0233
C	CHANGE R83 FROM 510 OHM TO 430 OHM	0262
D	CHANGE R159 FROM 1K TO 7K	0273
E	CHANGE CR19 FROM 1N4148 TO 1N34A	0291
F	ADDED (2) 10K, 1/4W ± 5% RESISTORS R184 AND R185	0383
G	ADDED (1) 22K, 1/4W ± 5% RESISTOR R186	0398
H	CHANGED R146 FROM 10K TO 27K, IC11 FROM CD4016 TO CD4066BE, R100 FROM 500 OHM TO 1K, ADDED PIN 7 TO P910	0672
J	NEXT ASSEMBLY WAS 981-040171	0790
K	C25 .47 WAS 0.1. ADDED C50 .1UF AND R187 2.7K	0797 0796 0783
L	LM3080AN WAS CA3080E	0801
M	R68 WAS 470K, R71 WAS 15K, R70 WAS 10K. (TEMPERATURE STABILITY OF CONTOUR GENERATOR)	1163


IN/OUT 1
SIG A
OUT/IN 2
OUT/IN 3
SIG B
IN/OUT 4
CONT 5 B
CONT 6 C
VSS 7
14 +VDD
13 CONT A
12 CONT D
11 IN/OUT
SIG D
10 OUT/IN
9 OUT/IN
SIG C
8 IN/OUT
SW A
SW D
SW B
SW C

FUNCTIONAL DIAGRAM
4016


14
2
11
6
13
8
3
1
5
10
12
7
4
9
P
N

92CS-25035

TERMINAL NO. 14 – V_{DD}

TERMINAL NO. 7 – V_{SS}

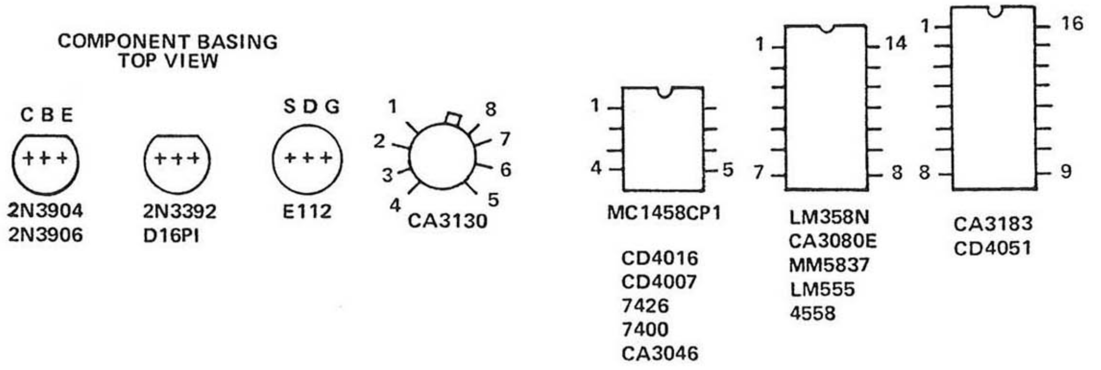
CD4007A FUNCTIONAL DIAGRAM

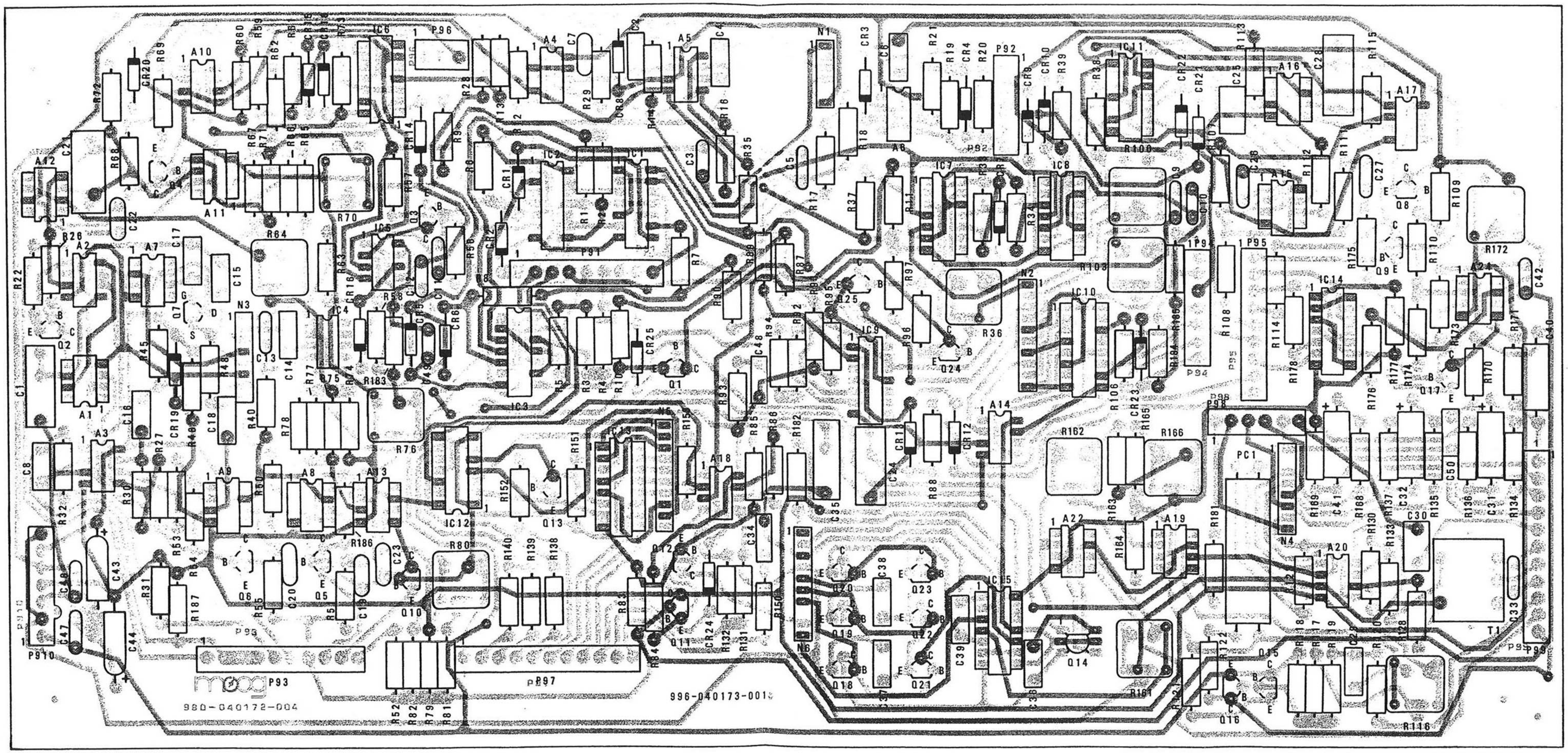
NOTES:

UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS 1/4W, ± 5%.
2. ALL CAPACITOR VALUES ARE IN MFD (uf).
3. ALL DIODES ARE 1N4148.
4. ALL TRANSISTORS ARE 2N3906.
5. BELOW SERIAL NUMBER 3549.
6. ——▶—— INDICATES SIGNAL PATH THROUGH VCF SECTION.

COMPONENT BASING
TOP VIEW

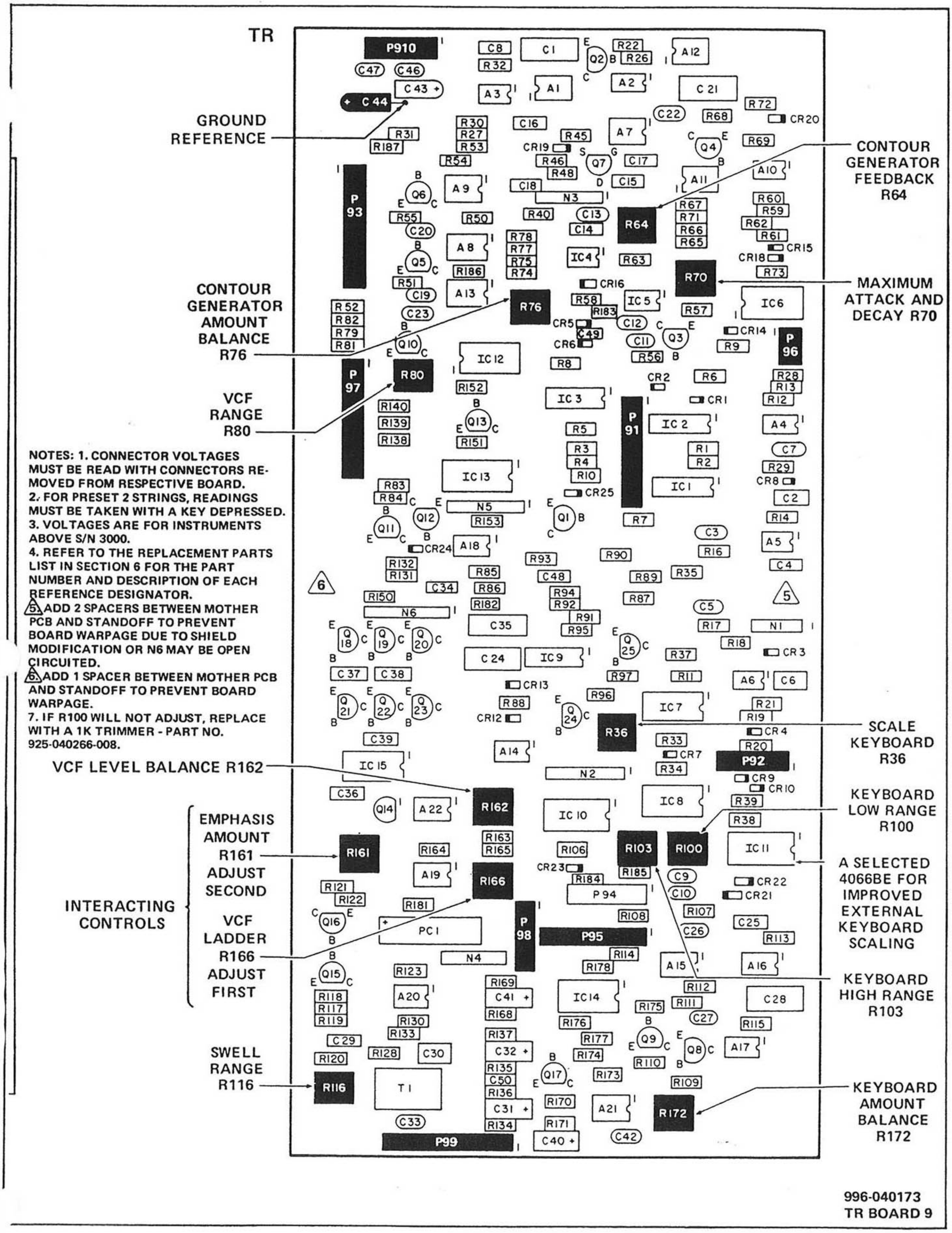

C B E
2N3904
2N3906
2N3392
D16PI
S D G
E112
1
2
3
4
5
6
7
8
CA3130
1
4
5
MC1458CP1
CD4016
CD4007
7426
7400
CA3046
1
7
14
8
LM358N
CA3080E
MM5837
LM555
4558
1
8
16
9
CA3183
CD4051


moog
980-040172-004
996-040173-001
P93
P97
P910
P99
P91
P92
P94
P95
P96
P98

NOTES: 1.
MUST BE
MOVED F
2. FOR PR
MUST BE
3. VOLTA
ABOVE S/
4. REFER
LIST IN SE
NUMBER
REFEREN
5. ADD 2 S
PCB AND
BOARD W.
MODIFICA
CIRCUITE
6. ADD 1 S
AND STA
WARPAGE
7. IF R100
WITH A 1K
925-04026

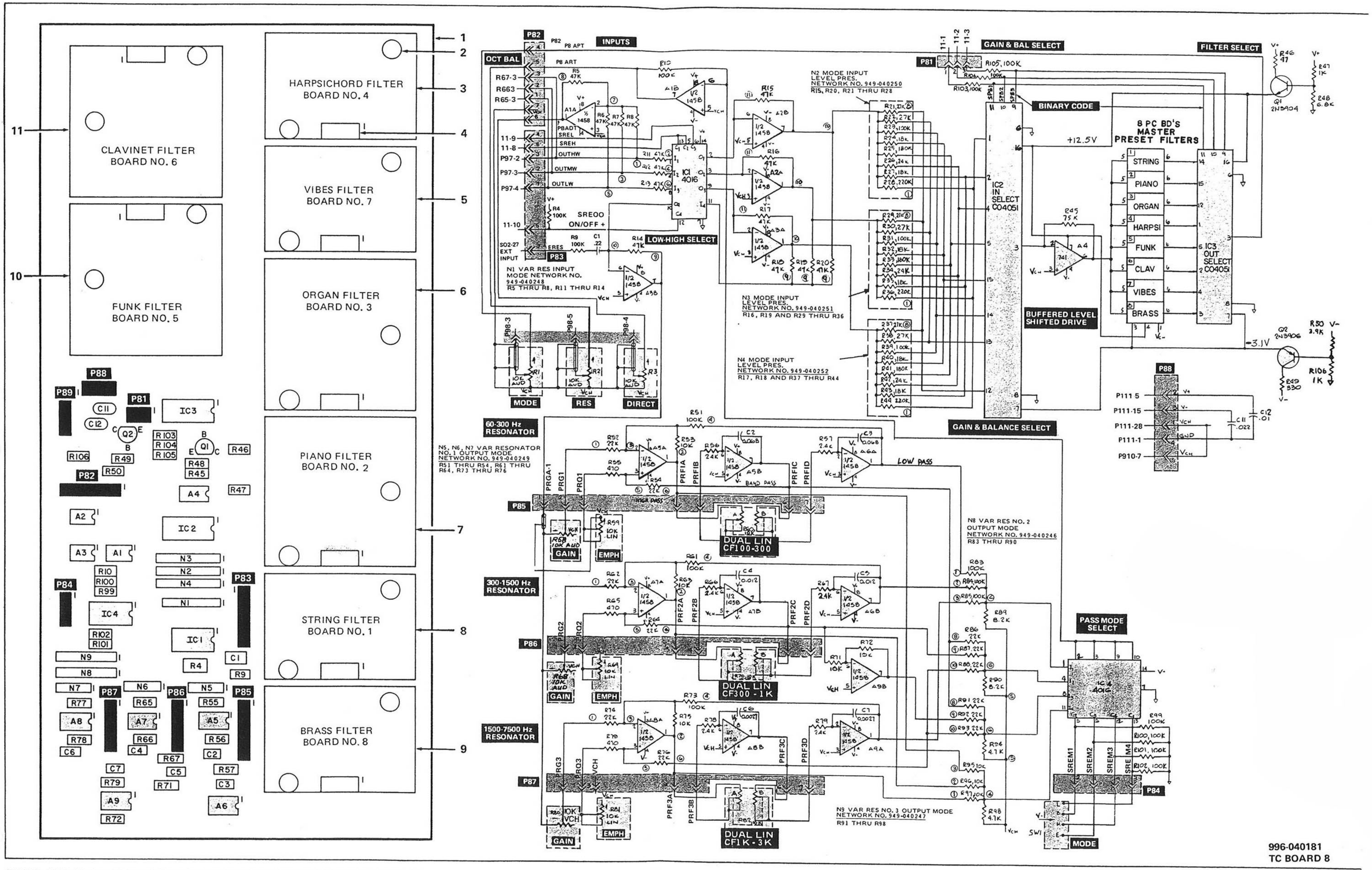
VCF

INT
C


TR
GROUND REFERENCE
CONTOUR GENERATOR AMOUNT BALANCE R76
VCF RANGE R80
VCF LEVEL BALANCE R162
EMPHASIS AMOUNT R161 ADJUST SECOND
INTERACTING CONTROLS
VCF LADDER R166 ADJUST FIRST
SWELL RANGE R116
CONTOUR GENERATOR FEEDBACK R64
MAXIMUM ATTACK AND DECAY R70
SCALE KEYBOARD R36
KEYBOARD LOW RANGE R100
A SELECTED 4066BE FOR IMPROVED EXTERNAL KEYBOARD SCALING
KEYBOARD HIGH RANGE R103
KEYBOARD AMOUNT BALANCE R172
P910
P93
P97
P91
P96
P92
P98
P95
P99
996-040173
TR BOARD 9

NOTES: 1. CONNECTOR VOLTAGES MUST BE READ WITH CONNECTORS REMOVED FROM RESPECTIVE BOARD.
2. FOR PRESET 2 STRINGS, READINGS MUST BE TAKEN WITH A KEY DEPRESSED.
3. VOLTAGES ARE FOR INSTRUMENTS ABOVE S/N 3000.
4. REFER TO THE REPLACEMENT PARTS LIST IN SECTION 6 FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.
△5 ADD 2 SPACERS BETWEEN MOTHER PCB AND STANDOFF TO PREVENT BOARD WARPAGE DUE TO SHIELD MODIFICATION OR N6 MAY BE OPEN CIRCUITED.
△6 ADD 1 SPACER BETWEEN MOTHER PCB AND STANDOFF TO PREVENT BOARD WARPAGE.
7. IF R100 WILL NOT ADJUST, REPLACE WITH A 1K TRIMMER - PART NO. 925-040266-008.

VOLTAGE CONTROLLED FILTER AND KEYBOARD CIRCUIT PRINTED CIRCUIT TR BOARD 9 ASSEMBLY


HARPSICHORD FILTER BOARD NO. 4
VIBES FILTER BOARD NO. 7
ORGAN FILTER BOARD NO. 3
PIANO FILTER BOARD NO. 2
STRING FILTER BOARD NO. 1
BRASS FILTER BOARD NO. 8
CLAVINET FILTER BOARD NO. 6
FUNK FILTER BOARD NO. 5
1
2
3
4
5
6
7
8
9
10
11
P88
P89
P81
P82
P83
P84
P85
P86
P87
IC3
IC2
IC1
IC4
A1
A2
A3
A4
A5
A6
A7
A8
A9
N1
N2
N3
N4
N5
N6
N7
N8
N9
Q1
Q2
INPUTS
OCT BAL
LOW-HIGH SELECT
MODE
RES
DIRECT
GAIN & BAL SELECT
BINARY CODE
FILTER SELECT
8 PC BD'S MASTER PRESET FILTERS
STRING
PIANO
ORGAN
HARPSI
FUNK
CLAV
VIBES
BRASS
IC2 IN SELECT C04051
IC3 OUT SELECT C04051
BUFFERED LEVEL SHIFTED DRIVE
GAIN & BALANCE SELECT
+12.5V
-3.1V
N1 VAR RES INPUT MODE NETWORK NO. 949-040248 R5 THRU R8, R11 THRU R14
N2 MODE INPUT LEVEL PRES. NETWORK NO. 949-040250 R15, R20, R21 THRU R28
N3 MODE INPUT LEVEL PRES. NETWORK NO. 949-040251 R16, R19 AND R29 THRU R36
N4 MODE INPUT LEVEL PRES. NETWORK NO. 949-040252 R17, R18 AND R37 THRU R44
N5, N6, N7 VAR RESONATOR NO. 1 OUTPUT MODE NETWORK NO. 949-040249 R51 THRU R54, R61 THRU R64, R73 THRU R76
N8 VAR RES NO. 2 OUTPUT MODE NETWORK NO. 949-040246 R83 THRU R90
N9 VAR RES NO. 3 OUTPUT MODE NETWORK NO. 949-040247 R91 THRU R98
60-300 Hz RESONATOR
300-1500 Hz RESONATOR
1500-7500 Hz RESONATOR
HIGH PASS
BAND PASS
LOW PASS
DUAL LIN CF100-300
DUAL LIN CF300-1K
DUAL LIN CF1K-3K
GAIN
EMPH
PASS MODE SELECT
MODE
SREM1
SREM2
SREM3
SREM4
P111-5
P111-15
P111-28
P111-1
P910-7
SREOO ON/OFF +
SO2-27 EXT INPUT
996-040181
TC BOARD 8

FIXED AND VARIABLE RESONANT FILTERS SCHEMATIC DIAGRAM TC BOARD 8

NETWORK RESISTOR VALUES

N	1	R5	R6	R7	R8	R11	R12	R13	R14		
		47K	47K	47K	47K	47K	47K	47K	47K		
N	2	R15	R20	R21	R22	R23	R24	R25	R26	R27	R28
		47K	47K	27K	27K	100K	18K	180K	24K	18K	220K
N	3	R16	R19	R29	R30	R31	R32	R33	R34	R35	R36
		47K	47K	27K	27K	100K	18K	180K	24K	18K	220K
N	4	R17	R18	R37	R38	R39	R40	R41	R42	R43	R44
		47K	47K	27K	27K	100K	18K	180K	24K	18K	220K
N	5	R51	R52	R53	R54						
		100K	22K	10K	22K						
N	6	R61	R62	R63	R64						
		100K	22K	10K	22K						
N	7	R73	R74	R75	R76						
		100K	22K	10K	22K						
N	8	R83	R84	R85	R86	R87	R88	R89	R90		
		100K	100K	100K	22K	22K	22K	8.2K	8.2K		
N	9	R91	R92	R93	R94	R95	R96	R97	R98		
		22K	22K	22K	4.7K	10K	10K	10K	4.7K		

FUTURE NETWORK RESISTOR VALUES

N	1	R5	R6	R7	R8	R11	R12	R13	R14		
N	2	R15	R20	R21	R22	R23	R24	R25	R26	R27	R28
N	3	R16	R19	R29	R30	R31	R32	R33	R34	R35	R36
N	4	R17	R18	R37	R38	R39	R40	R41	R42	R43	R44
N	5	R51	R52	R53	R54						
N	6	R61	R62	R63	R64						
N	7	R73	R74	R75	R76						
N	8	R83	R84	R85	R86	R87	R88	R89	R90		
N	9	R91	R92	R93	R94	R95	R96	R97	R98		

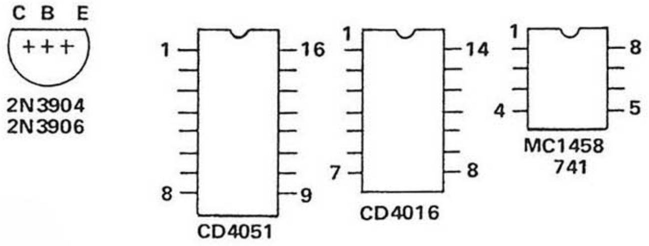
V.	DESCRIPTION	EO
\	REVISED AND RELEASED FOR PRODUCTION	0192
3	REVISED PER EO 0233	0233
:	UPDATE PER EO 0296	0296
)	P88-005 WAS -004 UPDATED FOR SERVICE MANUAL. [illegible]2, N3, N4 REVISED PER EO 0662. C11 .022UF WAS [illegible]1UF	0662
:	NEXT ASSEMBLY WAS 981-040179	0790
:	P83 REVISED PER EO	1120

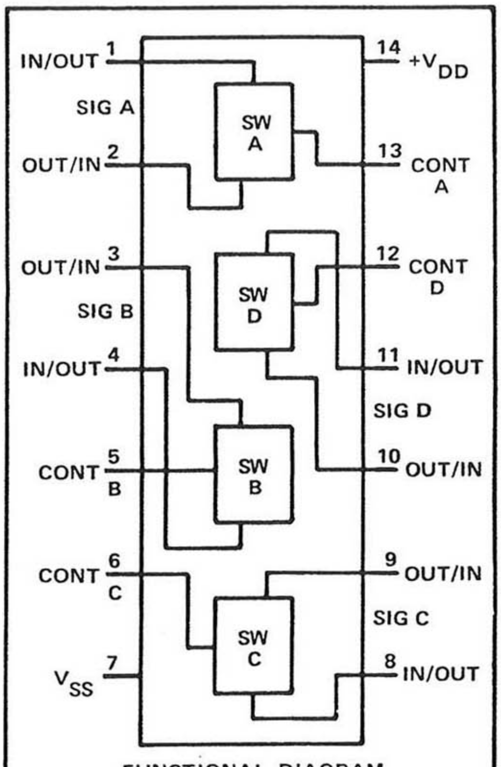
TES:

UNLESS OTHERWISE SPECIFIED –

1. ALL CAPACITOR VALUES ARE MFD (uf).
2. ALL RESISTOR VALUES ARE IN OHMS 1/4W, ± 5%.
3. REFER TO THE REPLACEMENT PARTS LIST IN VOLUME 1, SECTION 5 FOR THE PART NUMBER DESCRIPTION AND QUANTITY OF EACH INDEX NUMBER OR REFERENCE DESIGNATOR.
4. CONNECTOR DESIGNATORS INCLUDE A CODED REFERENCE PERTAINING TO ITS PRINTED CIRCUIT BOARD ORIGIN, I.E., P87 INDICATES IT IS PART OF BOARD 8. REFER TO TABLE 1-1 FOR OTHER BOARD NUMBERS AND NOMENCLATURE.

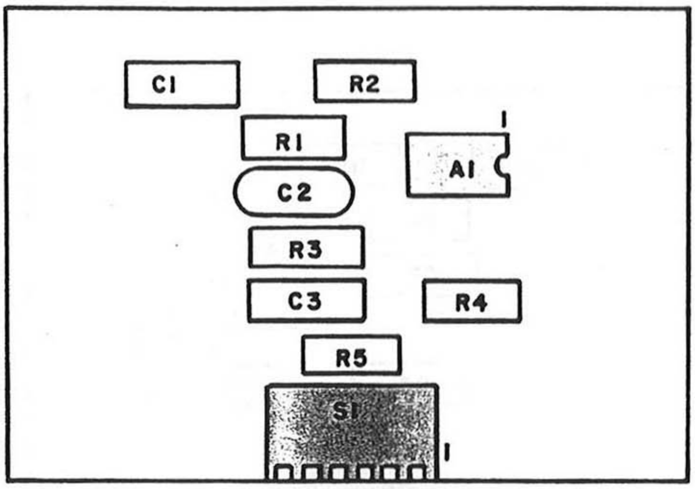
COMPONENT BASING (TOP VIEW)

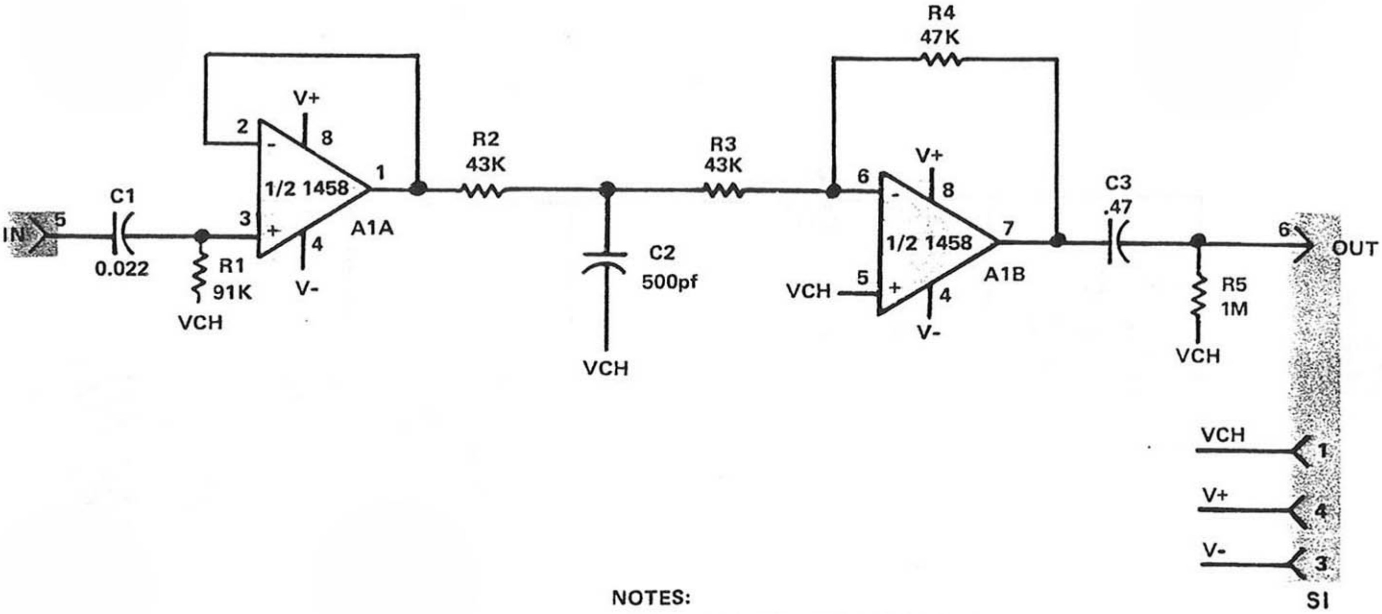

C B E
+++
2N3904
2N3906
1
16
8
9
CD4051
1
14
7
8
CD4016
1
8
4
5
MC1458
741


IN/OUT 1
SIG A
OUT/IN 2
OUT/IN 3
SIG B
IN/OUT 4
CONT 5 B
CONT 6 C
VSS 7
14 +VDD
13 CONT A
12 CONT D
11 IN/OUT
SIG D
10 OUT/IN
9 OUT/IN
SIG C
8 IN/OUT
SW A
SW D
SW B
SW C

FUNCTIONAL DIAGRAM
4016

NOTE: REFER TO THE REPLACEMENT PARTS LIST IN VOLUME I, SECTION 5 FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.


C1
R2
R1
A1
1
C2
R3
C3
R4
R5
S1
1


R4
47K
V+
2
8
-
1/2 1458
1
3
+
4
A1A
V-
C1
IN
5
0.022
R1
91K
VCH
R2
43K
C2
500pf
VCH
R3
43K
6
V+
8
1/2 1458
7
5
VCH
4
A1B
V-
C3
.47
6
OUT
R5
1M
VCH
VCH
1
V+
4
V-
3
S1

NOTES:

UNLESS OTHERWISE SPECIFIED:

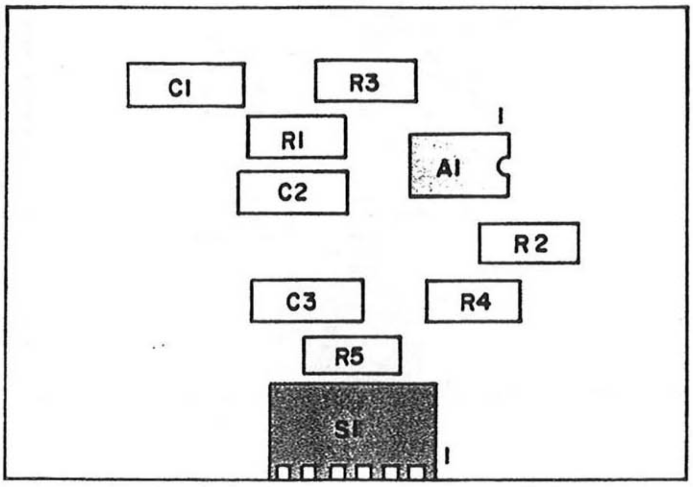
1. **ALL RESISTORS ARE IN OHMS 1/4W, ±5%**
2. **ALL CAPACITORS ARE IN MFD (uf)**

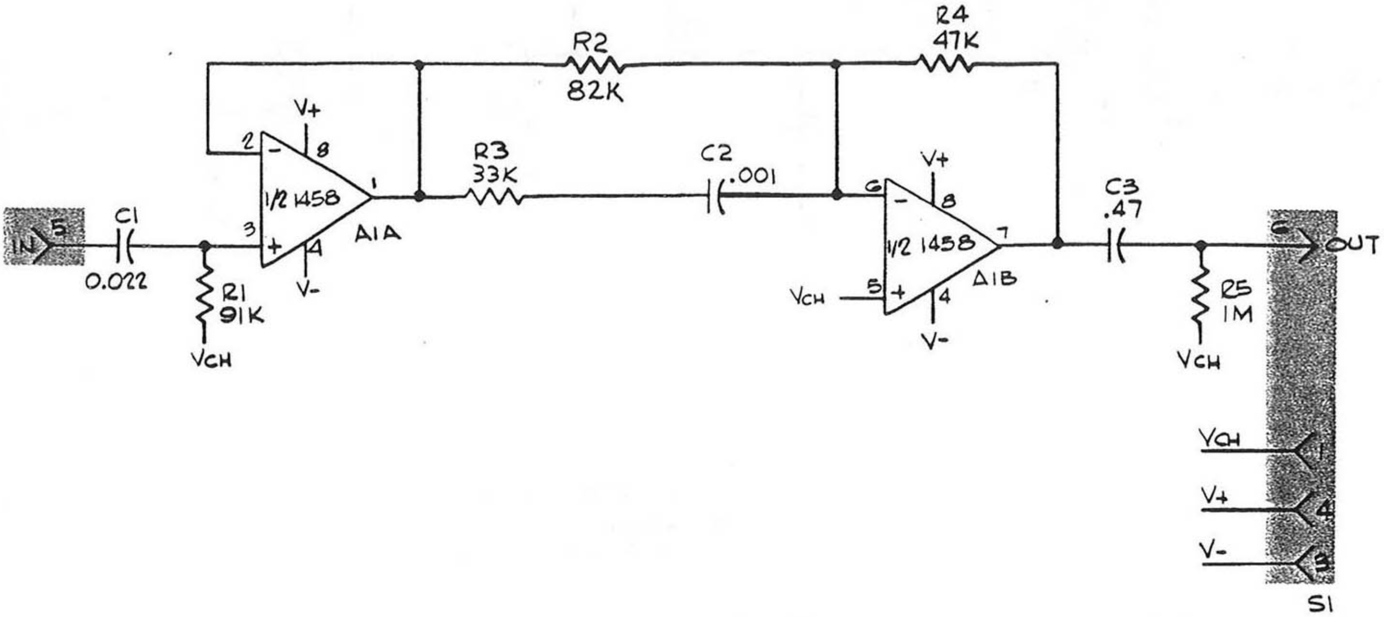
REV	DESCRIPTION	EO

996-040352

STRING FILTER BOARD NO. 1 (Version 1)

NOTE: REFER TO THE REPLACEMENT PARTS LIST IN VOLUME I, SECTION 5 FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.


C1
R3
R1
1
A1
C2
R2
C3
R4
R5
S1
1


R4
47K
R2
82K
V+
2
8
1
1/2 1458
3
4
A1A
IN
5
C1
0.022
R1
91K
VCH
V-
R3
33K
C2
.001
V+
6
8
1/2 1458
7
VCH
5
4
A1B
V-
C3
.47
6
OUT
R5
1M
VCH
VCH
1
V+
4
V-
3
S1

REV	DESCRIPTION	EO
	RELEASED FOR PRODUCTION	0192
A	CHANGED C3 FROM .01UF TO .47UF	0233
B	CHANGED PER EO 0277	0277
C	CHANGE R2, 82K WAS 680K	0654
D	NEXT ASSEMBLY WAS 981-040350	0790

NOTE:

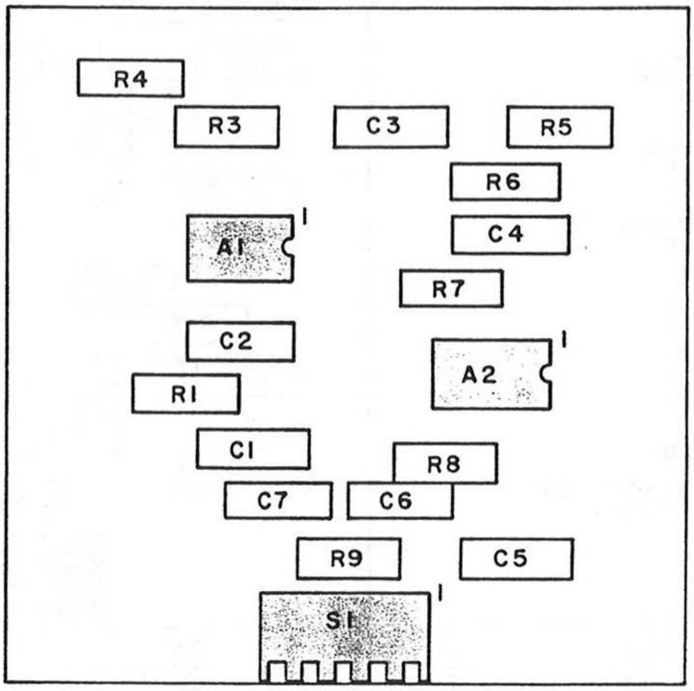
UNLESS OTHERWISE SPECIFIED:

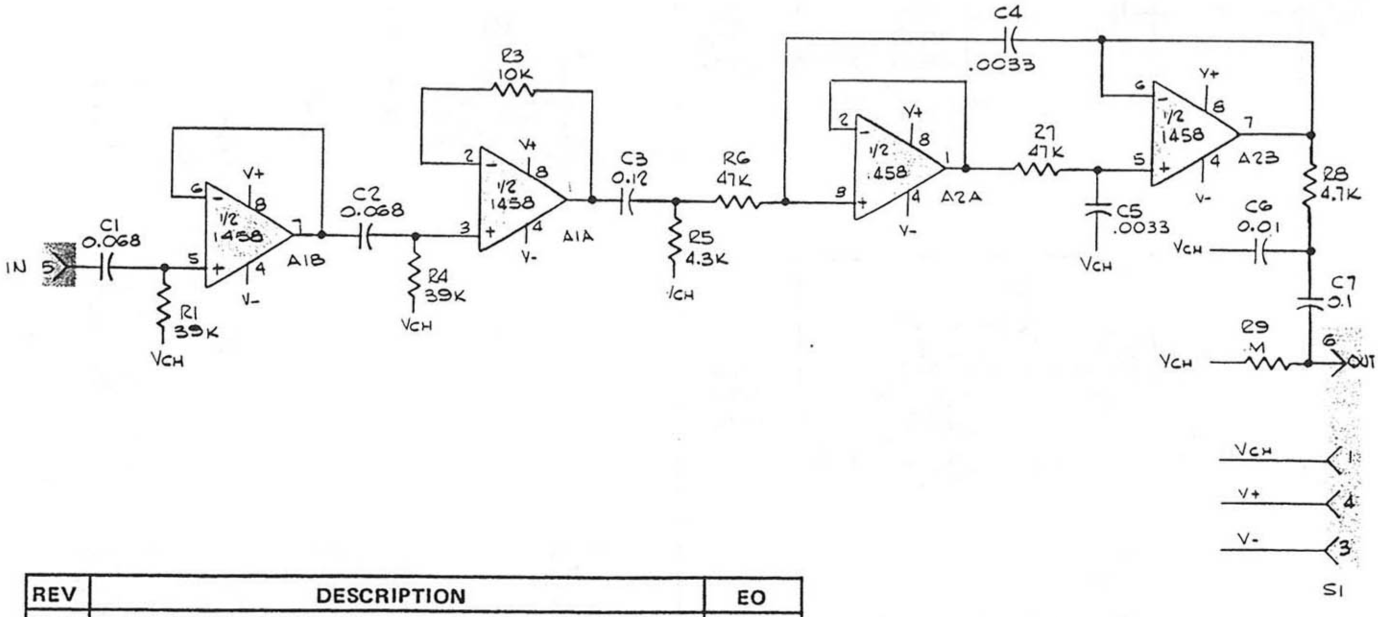
1. ALL RESISTORS ARE IN OHMS 1/4W, ± 5%.
2. ALL CAPACITORS ARE IN MFD (uf).

996-040352

STRING FILTER BOARD NO. 1 (Version 2)

NOTE: REFER TO THE REPLACEMENT PARTS LIST IN VOLUME I, SECTION 5 FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.


R4
R3
C3
R5
R6
A1
1
C4
R7
C2
A2
1
R1
C1
R8
C7
C6
R9
C5
S1
1


IN 5
C1
0.068
R1
39K
VCH
6
5
7
8
4
V+
V-
1/2
1458
A1B
C2
0.068
R4
39K
VCH
R3
10K
2
3
1
V+
V-
8
4
1/2
1458
A1A
C3
0.12
R5
4.3K
VCH
R6
47K
C4
.0033
2
3
1
Y+
V-
8
4
1/2
458
A2A
R7
47K
C5
.0033
VCH
6
5
7
V+
V-
8
4
1/2
1458
A2B
R8
4.7K
C6
0.01
VCH
C7
0.1
R9
M
VCH
6
OUT
VCH
1
V+
4
V-
3
S1

REV	DESCRIPTION	EO
	RELEASED FOR PRODUCTION	0192
A	CHANGED R2 FROM 100K TO 10K	0233
B	REMOVED R2, 10K	0634
C	NEXT ASS'Y WAS 981-040354	0790

NOTES:

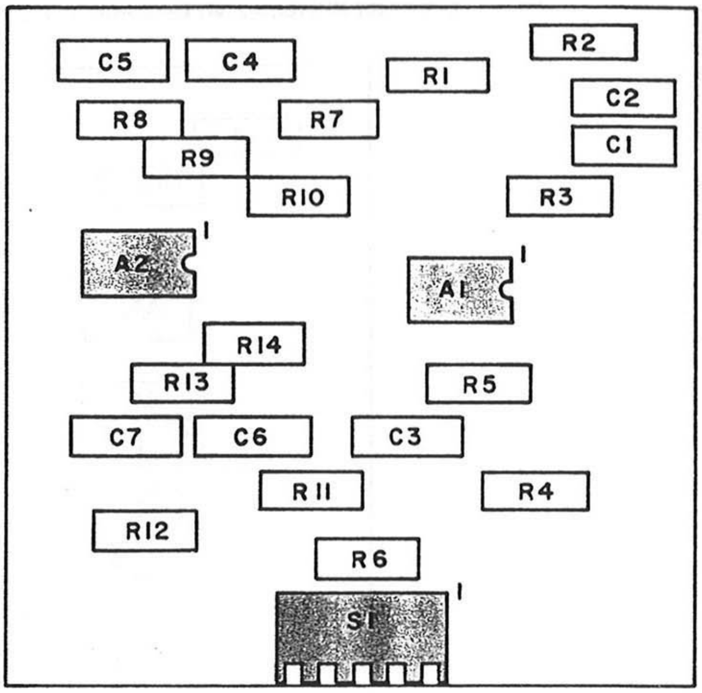
UNLESS OTHERWISE SPECIFIED:

1. **ALL RESISTORS ARE IN OHMS 1/4W, ± 5%.**
2. **ALL CAPACITORS ARE IN MFD (uf).**

996-040356

PIANO FILTER BOARD NO. 2

NOTE: REFER TO THE REPLACEMENT PARTS LIST IN VOLUME I, SECTION 5 FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.



C5
C4
R1
R2
C2
R8
R7
C1
R9
R10
R3
A2
1
A1
1
R14
R13
R5
C7
C6
C3
R11
R4
R12
R6
S1
1

FILTER 1 G = 13
F = 140Hz.
Q = 1.7

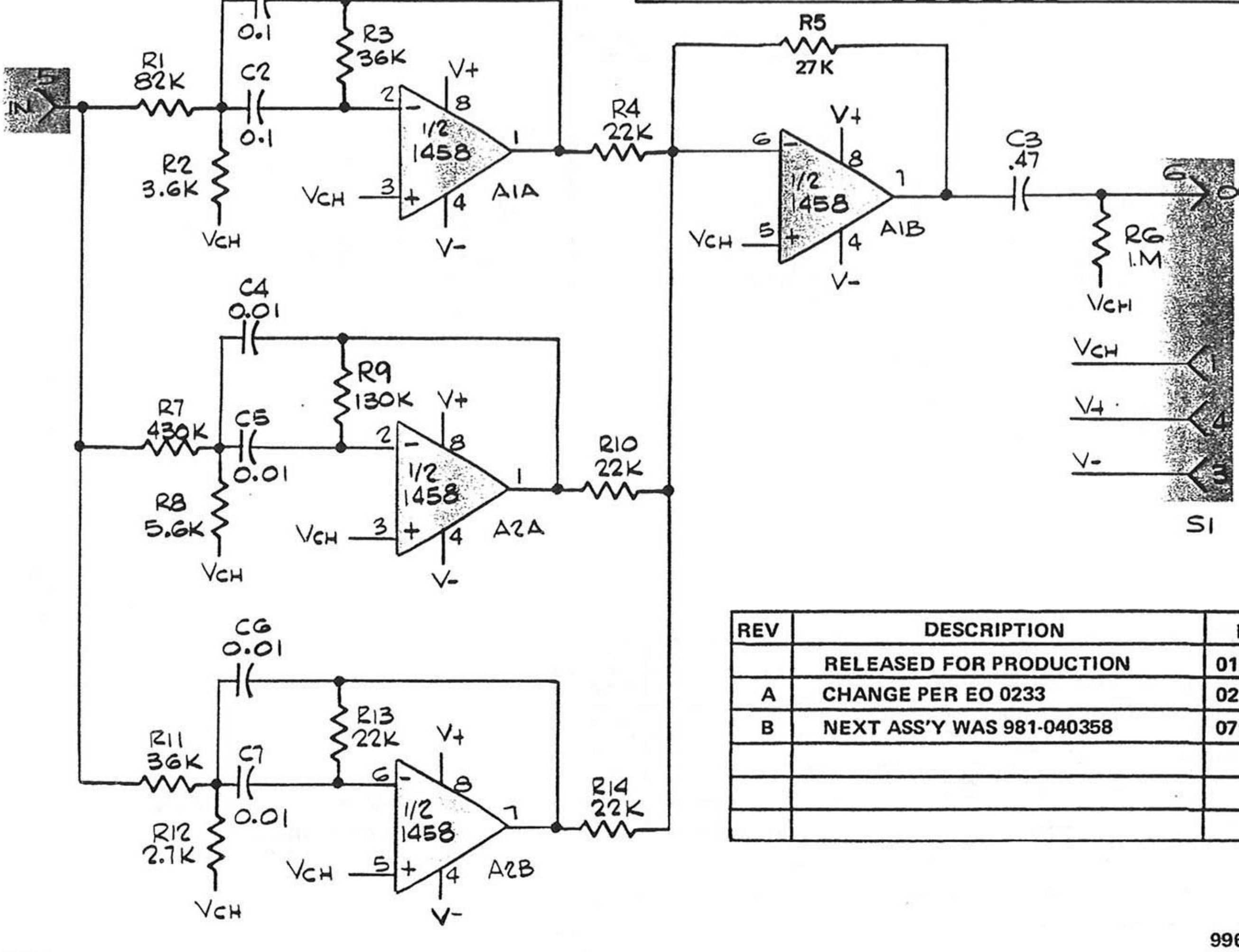
FILTER 2 G = 17
F = 600Hz.
Q = 2.4

FILTER 3 G = 10
F = 2050Hz.
Q = 1.5

NOTES:

UNLESS OTHERWISE SPECIFIED:

1. **ALL RESISTORS ARE IN OHMS 1/4W, ±5%.**
2. **ALL CAPACITORS ARE IN MFD (uf).**



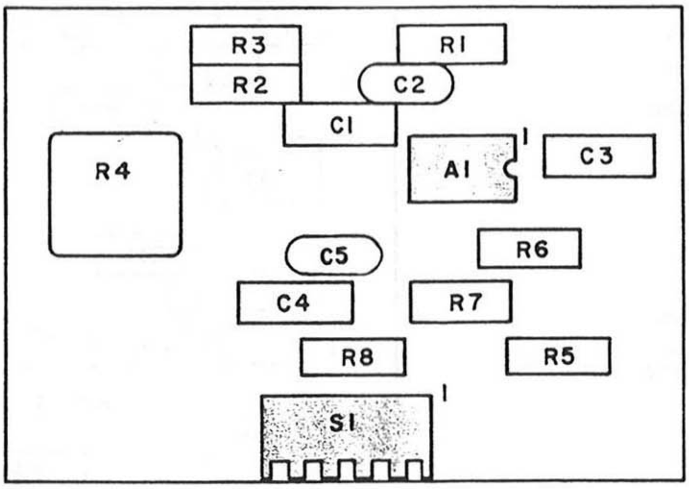
C1
0.1
R3
36K
R1
82K
C2
0.1
5
IN
V+
2
8
1/2
1458
1
R2
3.6K
VCH
3
4
A1A
V-
R5
27K
R4
22K
6
V+
8
1/2
1458
7
VCH
5
4
A1B
V-
C3
.47
6
OUT
R6
1.M
VCH
VCH
1
V+
4
V-
3
S1
C4
0.01
R9
130K
V+
R7
430K
C5
0.01
2
8
1/2
1458
1
R10
22K
R8
5.6K
VCH
3
4
A2A
V-
VCH
C6
0.01
R13
22K
V+
R11
36K
C7
0.01
6
8
1/2
1458
7
R14
22K
R12
2.7K
VCH
5
4
A2B
V-
VCH

REV	DESCRIPTION	EO
	RELEASED FOR PRODUCTION	0192
A	CHANGE PER EO 0233	0233
B	NEXT ASS'Y WAS 981-040358	0790

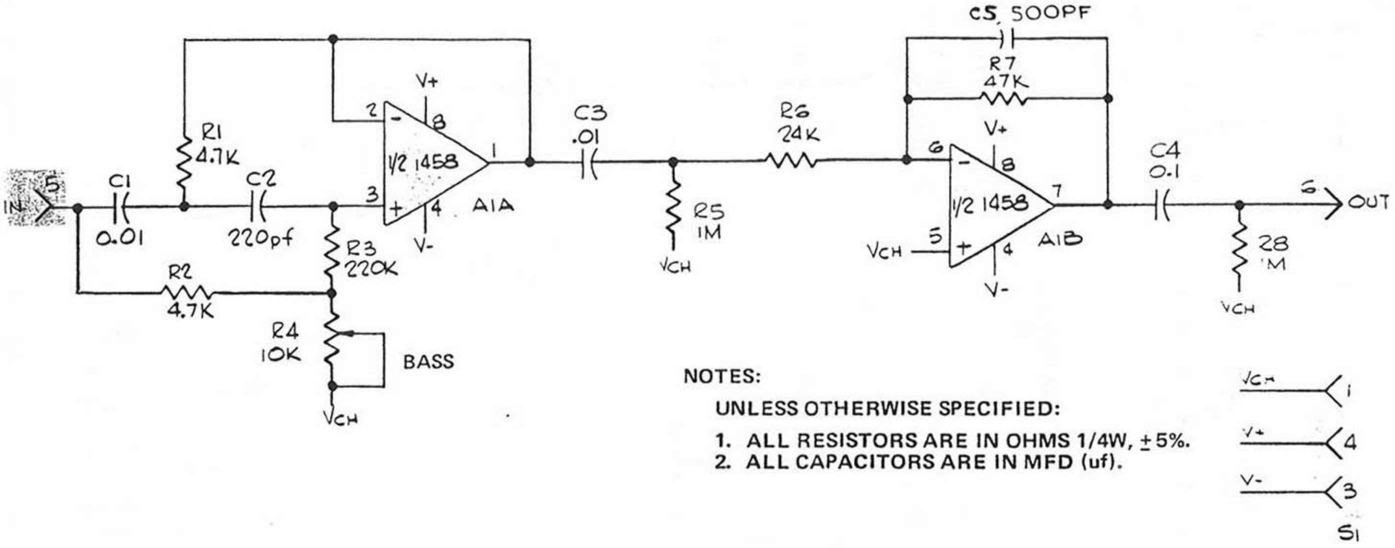
996-040360

ORGAN FILTER BOARD NO. 3

NOTE: REFER TO THE REPLACEMENT PARTS LIST IN VOLUME I, SECTION 5 FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.



R3
R1
R2
C2
C1
R4
A1
1
C3
C5
R6
C4
R7
R8
R5
S1
1



IN
5
C1
0.01
R1
4.7K
C2
220pf
R2
4.7K
R3
220K
R4
10K
BASS
VCH
2
3
8
4
1
V+
V-
1/2 1458
A1A
C3
.01
R5
1M
VCH
R6
24K
C5, 500PF
R7
47K
6
5
8
4
7
V+
V-
VCH
1/2 1458
A1B
C4
0.1
R8
1M
VCH
6
OUT
VCH
1
V+
4
V-
3
S1

NOTES:

UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTORS ARE IN OHMS 1/4W, ±5%.
2. ALL CAPACITORS ARE IN MFD (uf).

REV	DESCRIPTION	EO
	RELEASED FOR PRODUCTION	0192
A	CHANGE R7 FROM 100K TO 47K	0233
B	ADDED C5 500PF DISC CAPACITOR; CHANGED R2 FROM 220K TO 4.7K	0653
C	NEXT ASS'Y WAS 981-040362	0790

996-040364

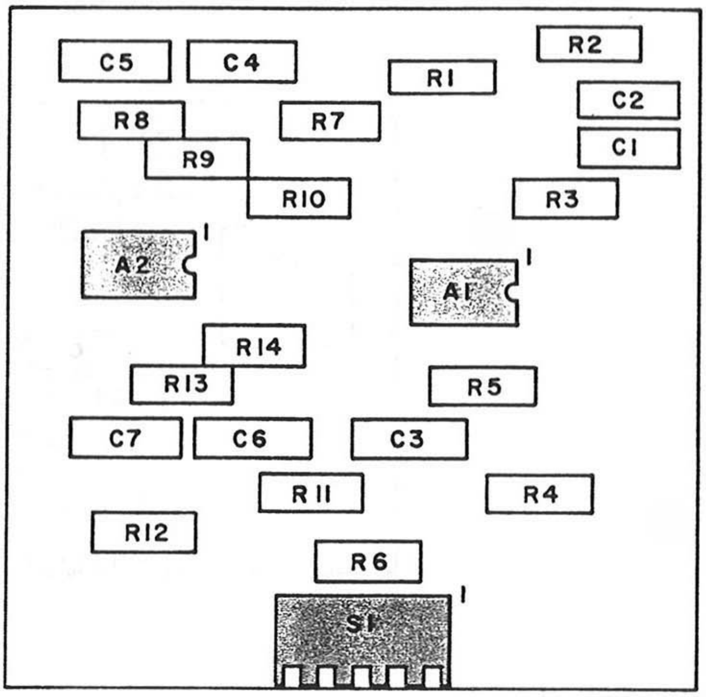
HARPSICHORD FILTER BOARD NO. 4

NOTE: REFER TO THE REPLACEMENT PARTS LIST IN VOLUME I, SECTION 5 FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.

FILTER 1 G = 10
F = 146Hz.
Q = 1.7

FILTER 2 G = -35
F = 1630Hz.
Q = 1.8

FILTER 3 G = 0
F = 3KHz.
Q = 2.7

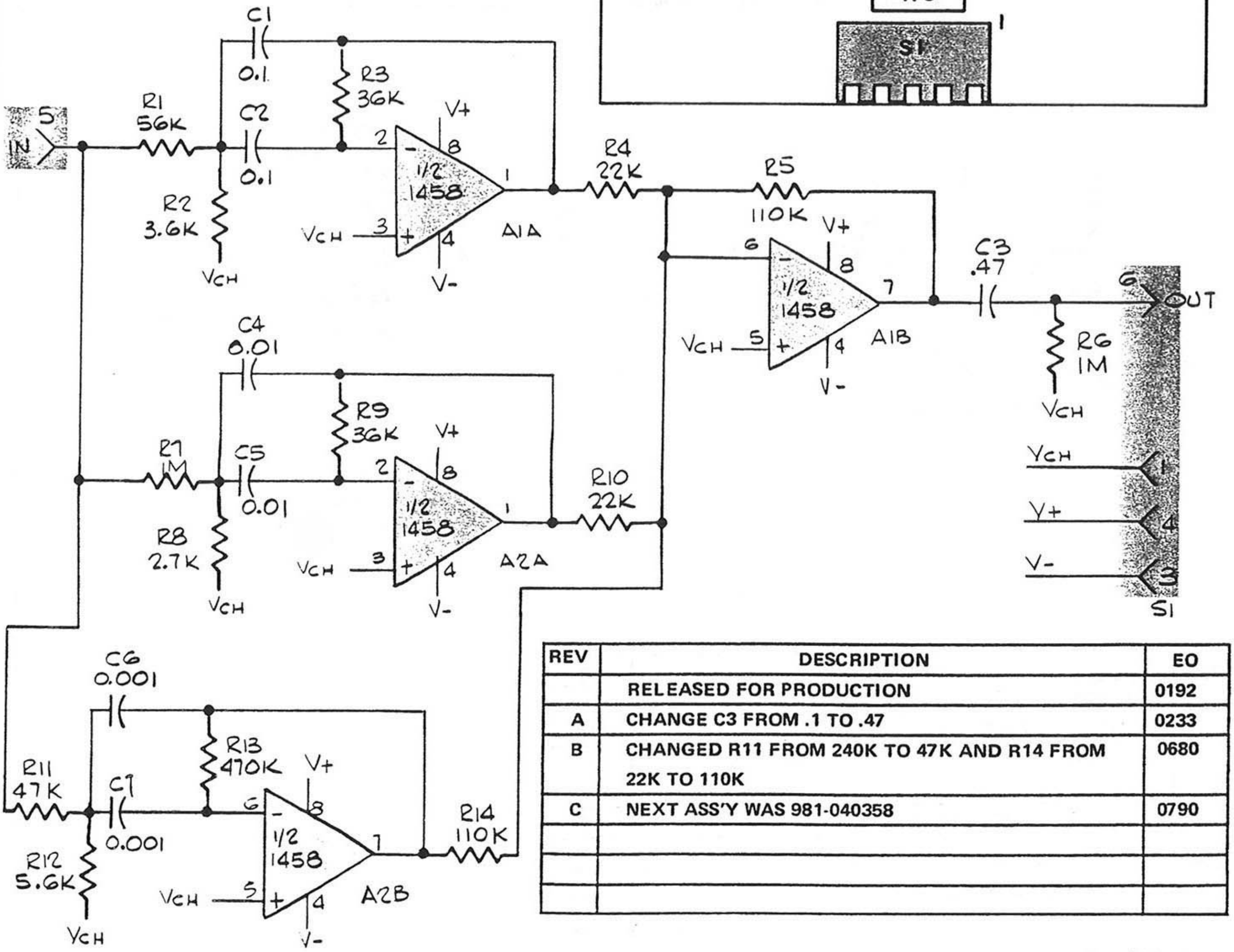


C5
C4
R1
R2
C2
C1
R8
R7
R9
R10
R3
A2
1
A1
1
R14
R13
R5
C7
C6
C3
R11
R4
R12
R6
S1
1

NOTES:

UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTORS ARE IN OHMS 1/4W, ±5%.
2. ALL CAPACITORS ARE IN MFD (uf).



C1
0.1
R3
36K
R1
56K
C2
0.1
IN
5
R2
3.6K
VCH
2
8
1
3
4
1/2
1458
V+
V-
A1A
R4
22K
R5
110K
V+
6
8
7
5
4
1/2
1458
A1B
VCH
V-
C3
.47
6
OUT
R6
1M
VCH
VCH
1
V+
4
V-
3
S1
C4
0.01
R9
36K
V+
R7
1M
C5
0.01
2
8
1
3
4
1/2
1458
A2A
R10
22K
R8
2.7K
VCH
V-
C6
0.001
R13
470K
V+
R11
47K
C7
0.001
6
8
7
5
4
1/2
1458
A2B
R14
110K
R12
5.6K
VCH
V-

REV	DESCRIPTION	EO
	RELEASED FOR PRODUCTION	0192
A	CHANGE C3 FROM .1 TO .47	0233
B	CHANGED R11 FROM 240K TO 47K AND R14 FROM 22K TO 110K	0680
C	NEXT ASS'Y WAS 981-040358	0790

996-040366

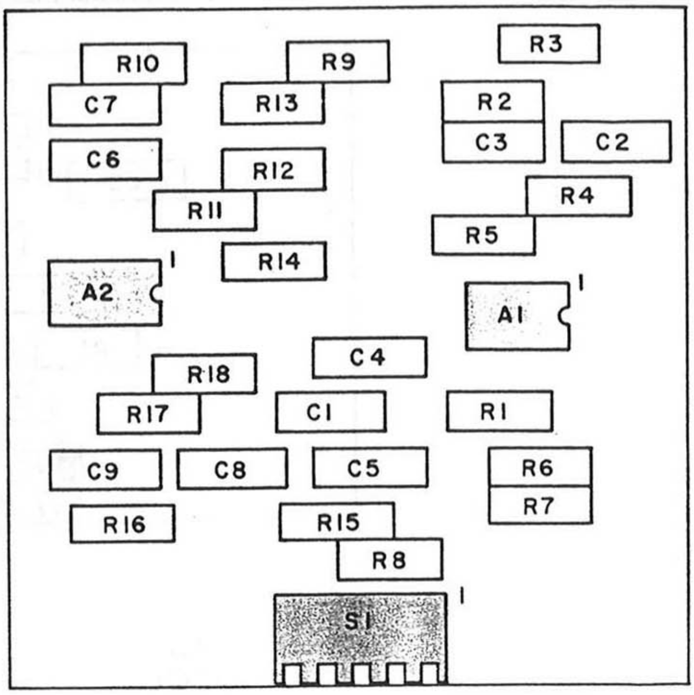
FUNK FILTER BOARD NO. 5

NOTE: REFER TO THE REPLACEMENT PARTS LIST IN VOLUME I, SECTION 5 FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.

FILTER 1 G = 6.4
F = 4.2KHz.
Q = 1.5

FILTER 2 G = 15
F = 450Hz.
Q = 2.2

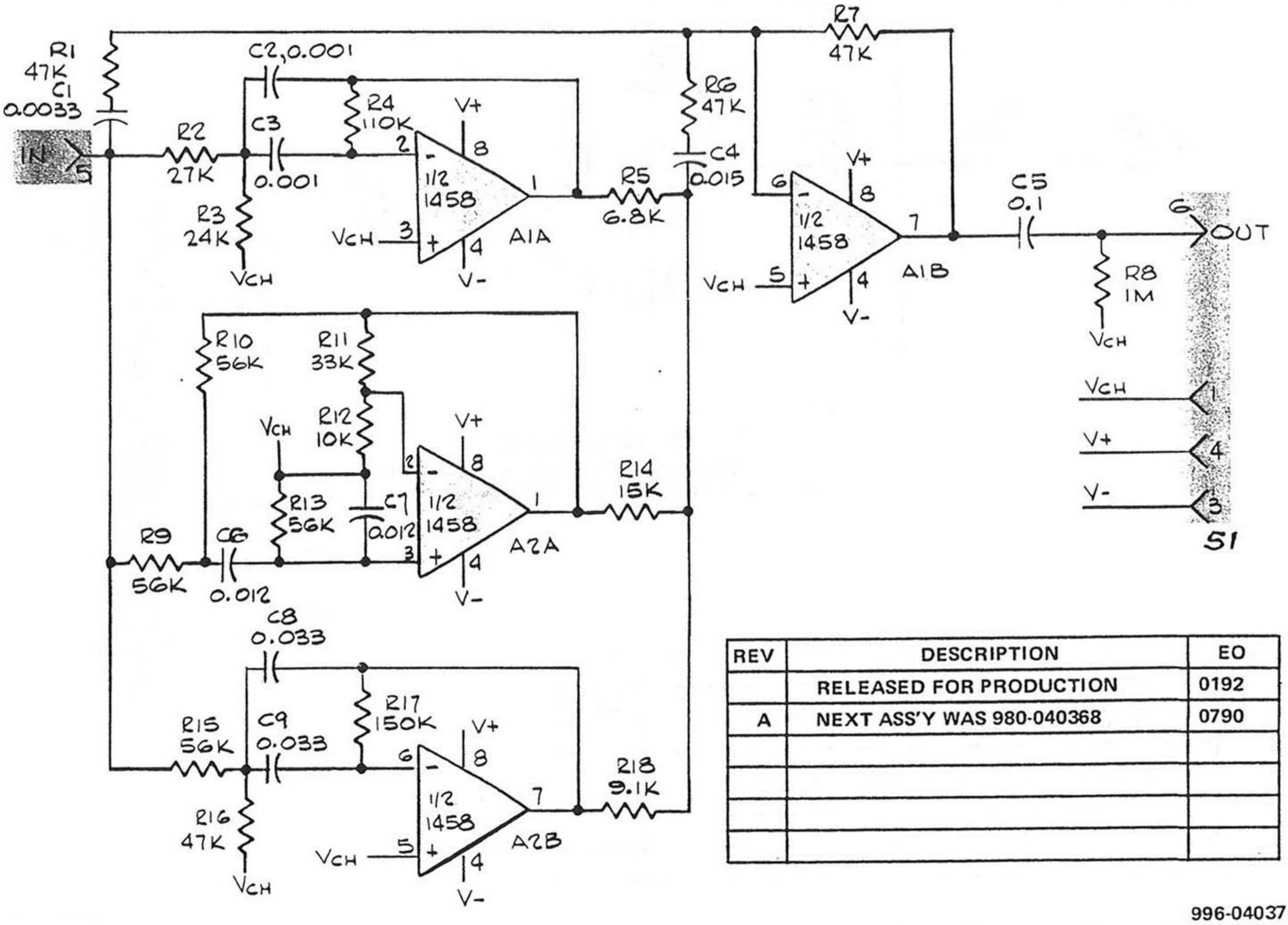
FILTER 3 G = 4.4
F = 90Hz.
Q = 1.3


R10
R9
R3
C7
R13
R2
C3
C2
C6
R12
R11
R4
R5
R14
A2
1
A1
1
C4
R18
R17
C1
R1
C9
C8
C5
R6
R7
R16
R15
R8
S1
1

NOTES:

UNLESS OTHERWISE SPECIFIED:

1. **ALL RESISTORS ARE IN OHMS 1/4W, ± 5%.**
2. **ALL CAPACITORS ARE IN MFD (uf).**

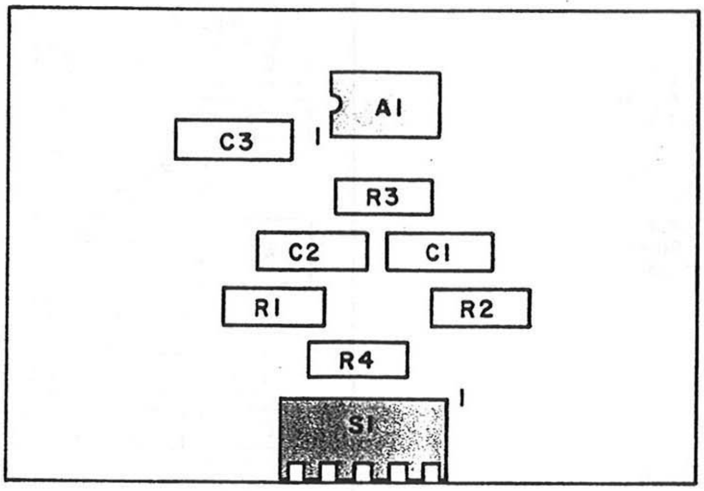

R1
47K
C1
0.0033
IN
5
R2
27K
C2, 0.001
C3
0.001
R3
24K
VCH
R4
110K
V+
2
8
1/2
1458
1
VCH
3
4
A1A
V-
R5
6.8K
R6
47K
C4
0.015
R7
47K
6
V+
8
1/2
1458
7
VCH
5
4
A1B
V-
C5
0.1
6
OUT
R8
1M
VCH
VCH
1
V+
4
V-
3
S1
R10
56K
R11
33K
R12
10K
VCH
R13
56K
C7
0.012
V+
2
8
1/2
1458
1
3
4
A2A
V-
R14
15K
R9
56K
C6
0.012
C8
0.033
R17
150K
R15
56K
C9
0.033
V+
6
8
1/2
1458
7
R18
9.1K
R16
47K
VCH
VCH
5
4
A2B
V-
VCH

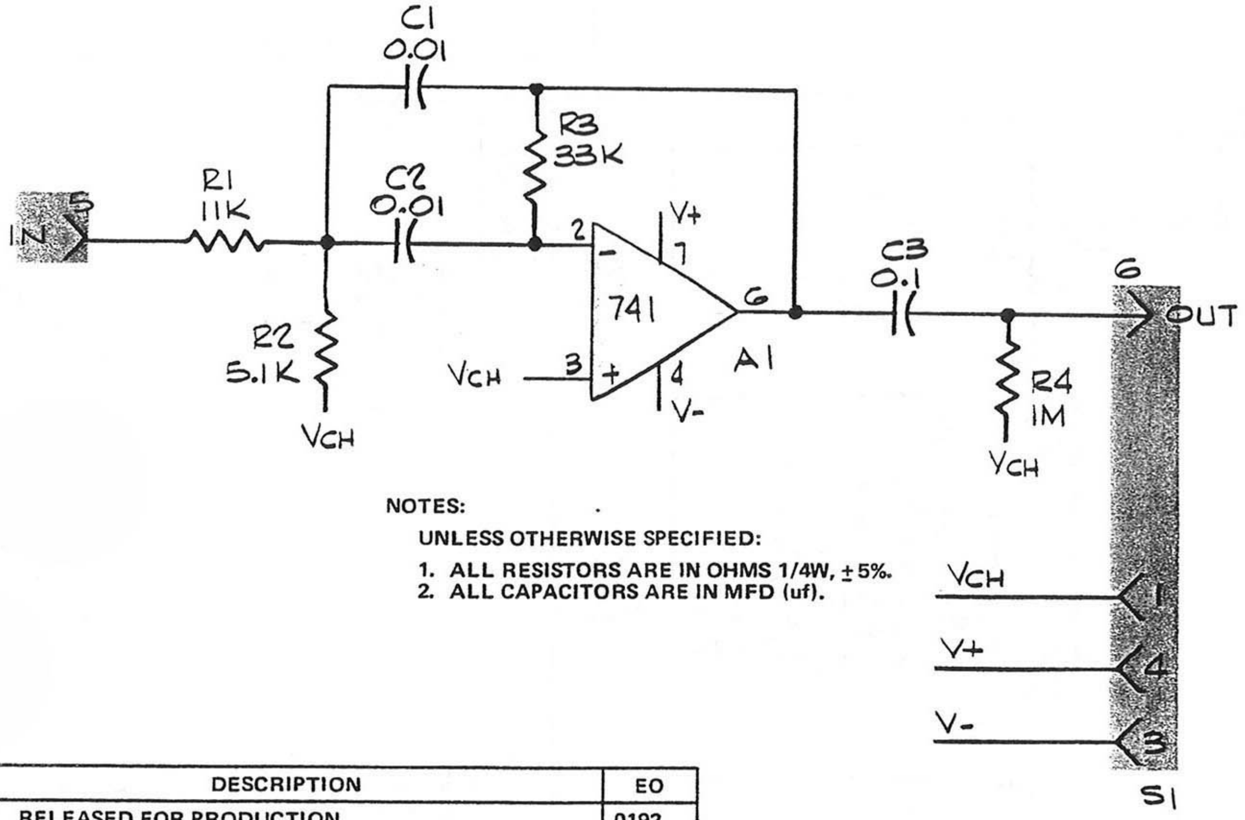
REV	DESCRIPTION	EO
	RELEASED FOR PRODUCTION	0192
A	NEXT ASS'Y WAS 980-040368	0790

996-040370

CLAVINET FILTER BOARD NO. 6

NOTE: REFER TO THE REPLACEMENT PARTS LIST IN VOLUME I, SECTION 5 FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.


A1
1
C3
R3
C2
C1
R1
R2
R4
1
S1


C1
0.01
R3
33K
R1
11K
C2
0.01
IN
5
2
V+
7
741
6
A1
C3
0.1
6
OUT
R2
5.1K
VCH
VCH
3
4
V-
R4
1M
VCH
VCH
1
V+
4
V-
3
S1

NOTES:

UNLESS OTHERWISE SPECIFIED:

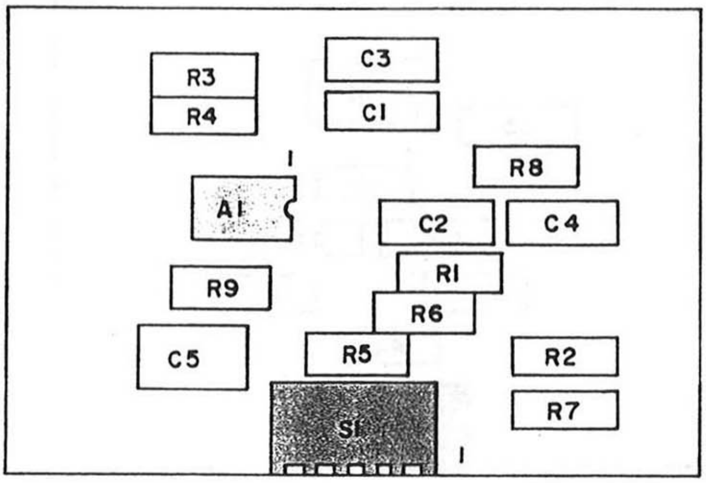
1. **ALL RESISTORS ARE IN OHMS 1/4W, ± 5%.**
2. **ALL CAPACITORS ARE IN MFD (uf).**

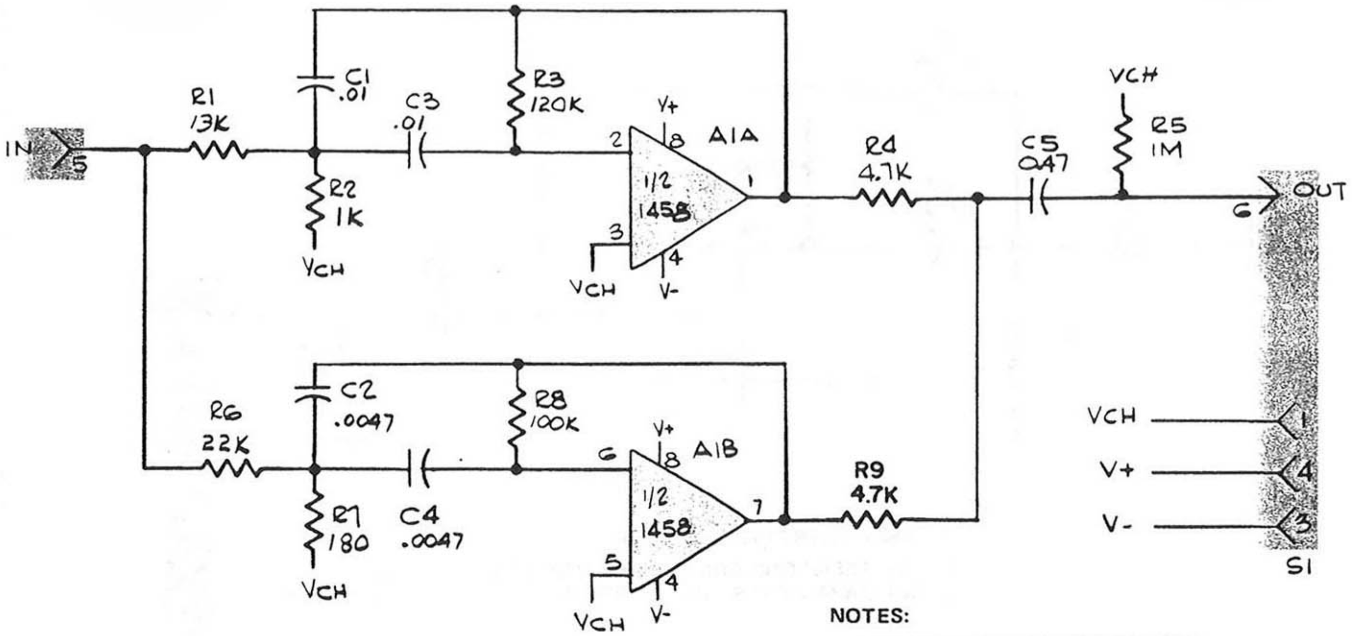
REV	DESCRIPTION	EO
	RELEASED FOR PRODUCTION	0192
A	NEXT ASS'Y WAS 981-040372	0790

996-040374

VIBES FILTER BOARD NO. 7

NOTE: REFER TO THE REPLACEMENT PARTS LIST IN VOLUME I, SECTION 5 FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.


R3
R4
C3
C1
1
A1
R8
C2
C4
R9
R1
R6
C5
R5
R2
S1
R7
1


IN
5
R1
13K
C1
.01
R2
1K
VCH
C3
.01
R3
120K
V+
2
8
A1A
1/2
1458
1
3
4
VCH
V-
R4
4.7K
C5
.047
VCH
R5
1M
OUT
6
R6
22K
C2
.0047
R7
180
VCH
C4
.0047
R8
100K
V+
6
8
A1B
1/2
1458
7
5
4
VCH
V-
R9
4.7K
VCH
1
V+
4
V-
3
S1

NOTES:

UNLESS OTHERWISE SPECIFIED:

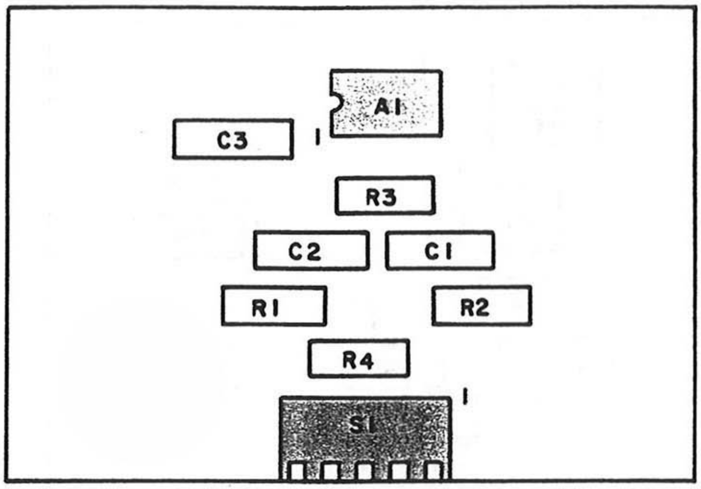
1. **ALL RESISTORS ARE IN OHMS 1/4W, ±5%.**
2. **ALL CAPACITORS ARE IN MFD (uf).**

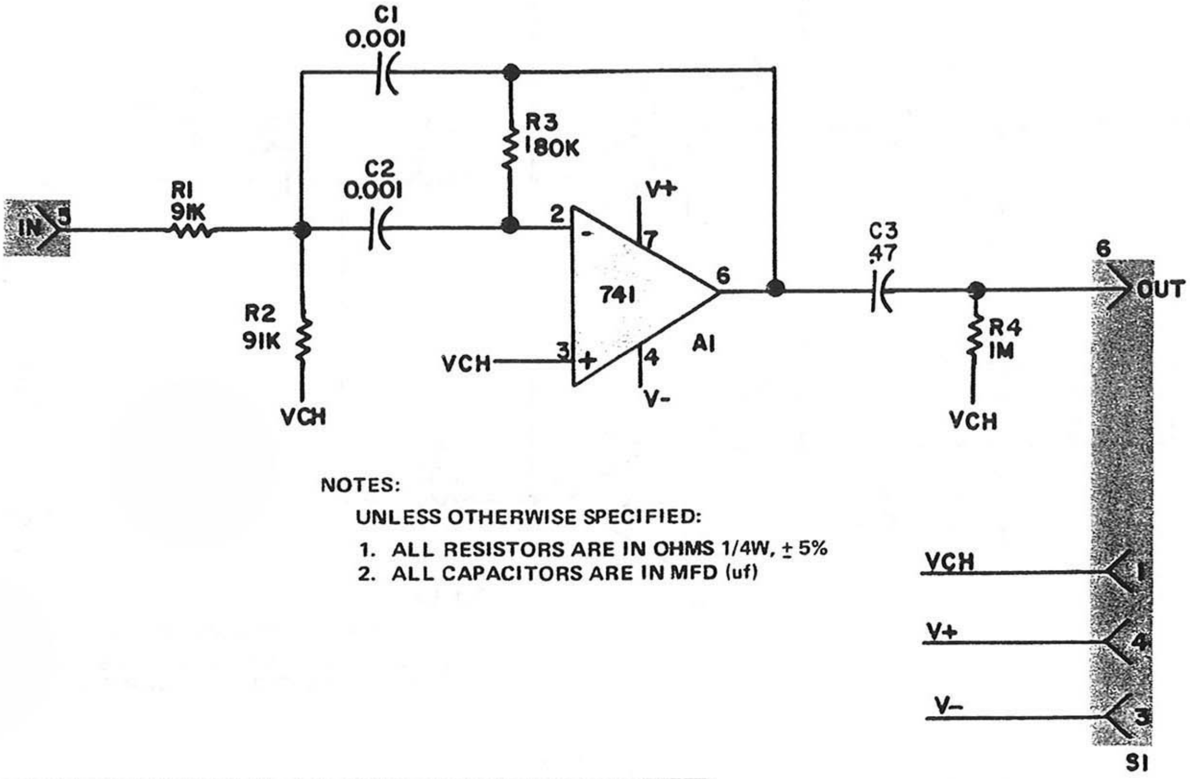
REV	DESCRIPTION	EO
	RELEASED FOR PRODUCTION	0233
A	NEXT ASS'Y WAS 981-040651	0790

996-040653

BRASS FILTER BOARD NO. 8 (Version 1)

NOTE: REFER TO THE REPLACEMENT PARTS LIST IN VOLUME I, SECTION 5 FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.


A1
1
C3
R3
C2
C1
R1
R2
R4
1
S1


C1
0.001
R3
180K
C2
0.001
R1
91K
IN
5
2
-
V+
7
741
6
C3
.47
6
OUT
R2
91K
VCH
VCH
3
+
4
A1
V-
R4
1M
VCH
VCH
1
V+
4
V–
3
S1

NOTES:

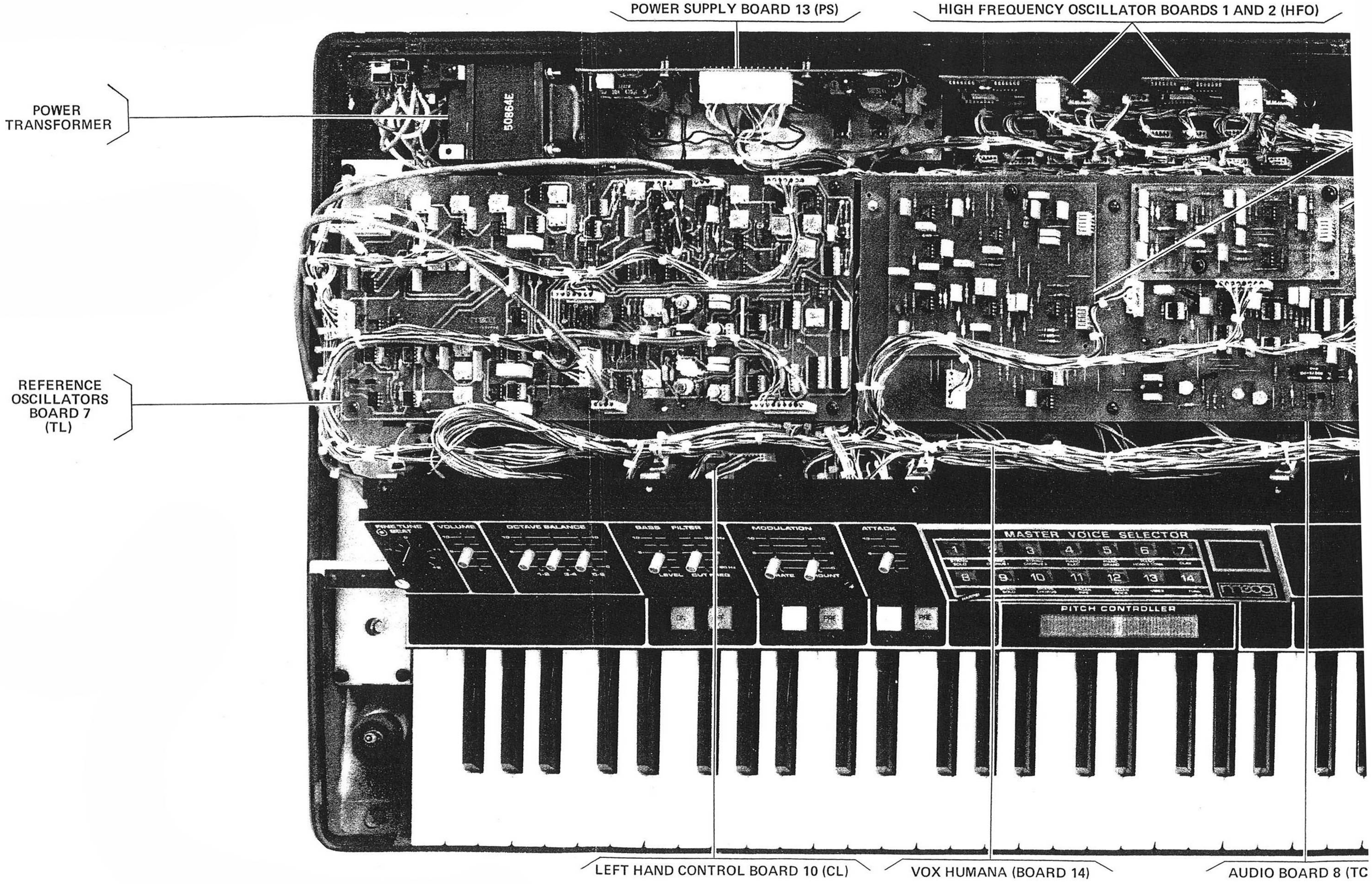
UNLESS OTHERWISE SPECIFIED:

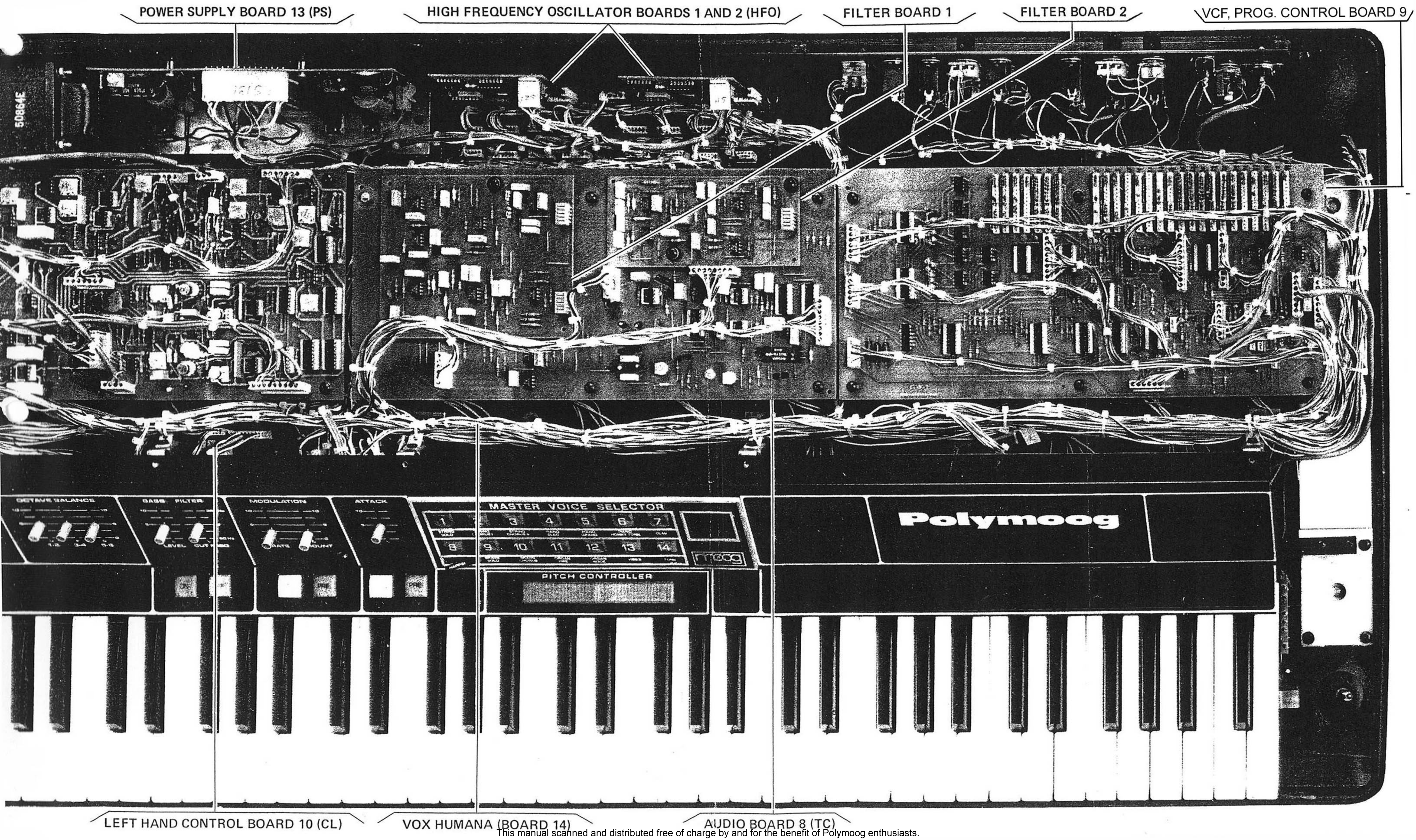
1. ALL RESISTORS ARE IN OHMS 1/4W, ± 5%
2. ALL CAPACITORS ARE IN MFD (uf)

REV	DESCRIPTION	EO
A	CHANGED C3 FROM .1 TO .47UF	0233

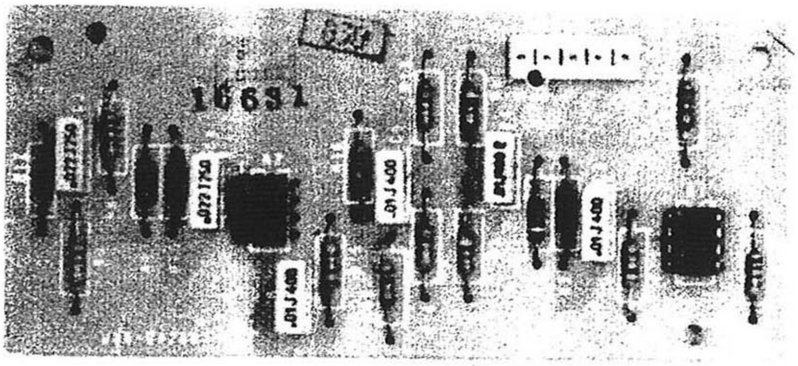
996-040374

BRASS FILTER BOARD NO. 8 (Version 2)


POWER SUPPLY BOARD 13 (PS)
HIGH FREQUENCY OSCILLATOR BOARDS 1 AND 2 (HFO)
POWER TRANSFORMER
REFERENCE OSCILLATORS BOARD 7 (TL)
LEFT HAND CONTROL BOARD 10 (CL)
VOX HUMANA (BOARD 14)
AUDIO BOARD 8 (TC
FINE TUNE
VOLUME
OCTAVE BALANCE
BASS FILTER
MODULATION
ATTACK
MASTER VOICE SELECTOR
PITCH CONTROLLER
moog

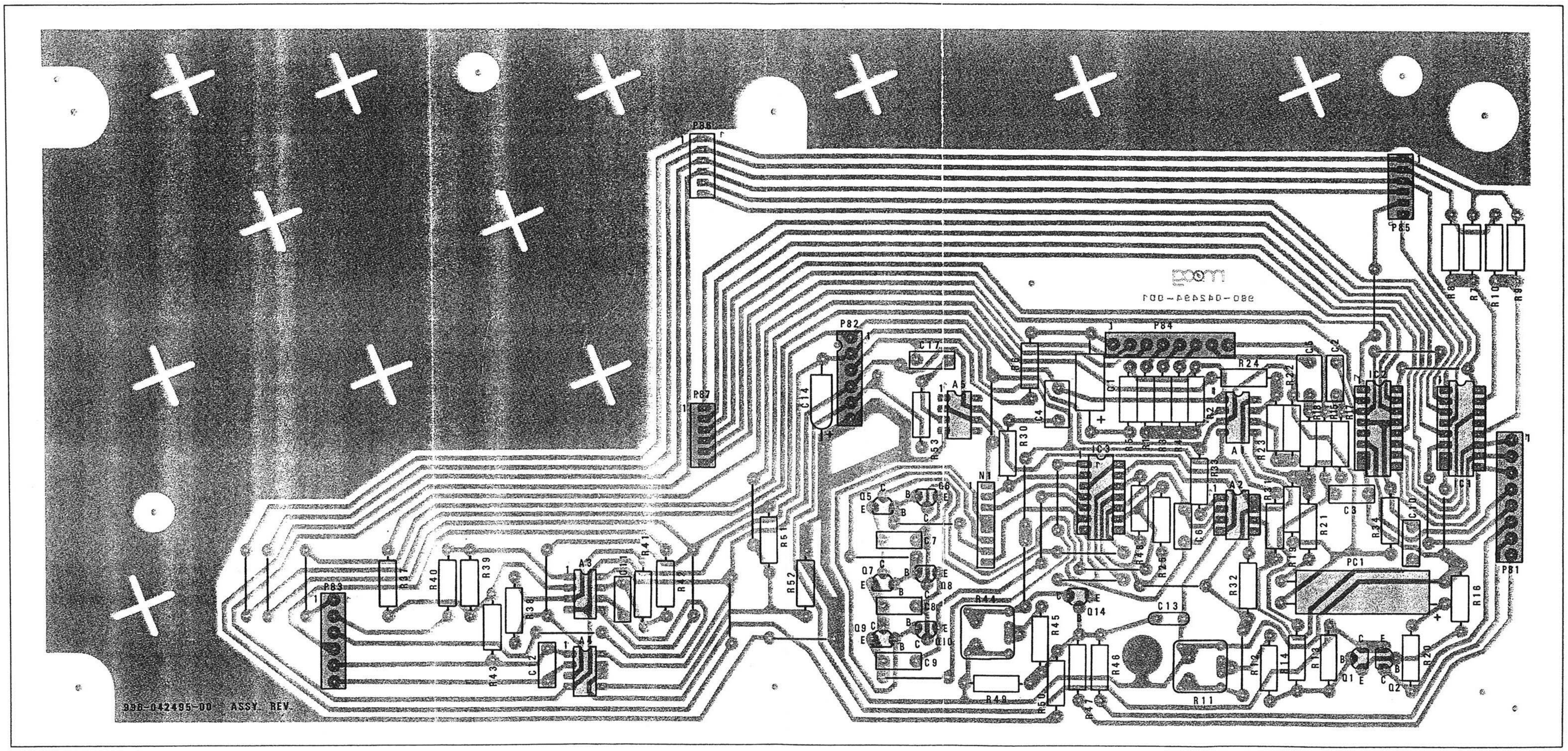

POWER SUPPLY BOARD 13 (PS)
HIGH FREQUENCY OSCILLATOR BOARDS 1 AND 2 (HFO)
FILTER BOARD 1
FILTER BOARD 2
VCF, PROG. CONTROL BOARD 9
OCTAVE BALANCE
BASS FILTER
MODULATION
ATTACK
MASTER VOICE SELECTOR
PITCH CONTROLLER
Polymoog
moog
LEFT HAND CONTROL BOARD 10 (CL)
VOX HUMANA (BOARD 14)
AUDIO BOARD 8 (TC)

M CONTROL
RD 9
TR)



VOX HUMANA BOARD 14

REV
A
B
C
D
E
F
G
H
J
K
L


P86
P85
P84
P82
P87
P83
P81
IC1
IC2
IC3
A1
A2
A3
A4
A5
A6
N1
PC1
Q1
Q2
Q5
Q6
Q7
Q8
Q9
Q10
Q14
C3
C4
C7
C8
C9
C10
C11
C12
C13
C14
C15
C16
C17
R7
R8
R9
R10
R11
R12
R13
R14
R16
R19
R20
R21
R22
R23
R24
R26
R30
R32
R33
R34
R37
R38
R39
R40
R41
R42
R43
R44
R45
R46
R47
R48
R49
R50
R52
R53
R61
980-042494-001
996-042495-00 ASSY. REV.

NOTE
RE
LI
TH
OF

NOT
U
1
2

E
2N

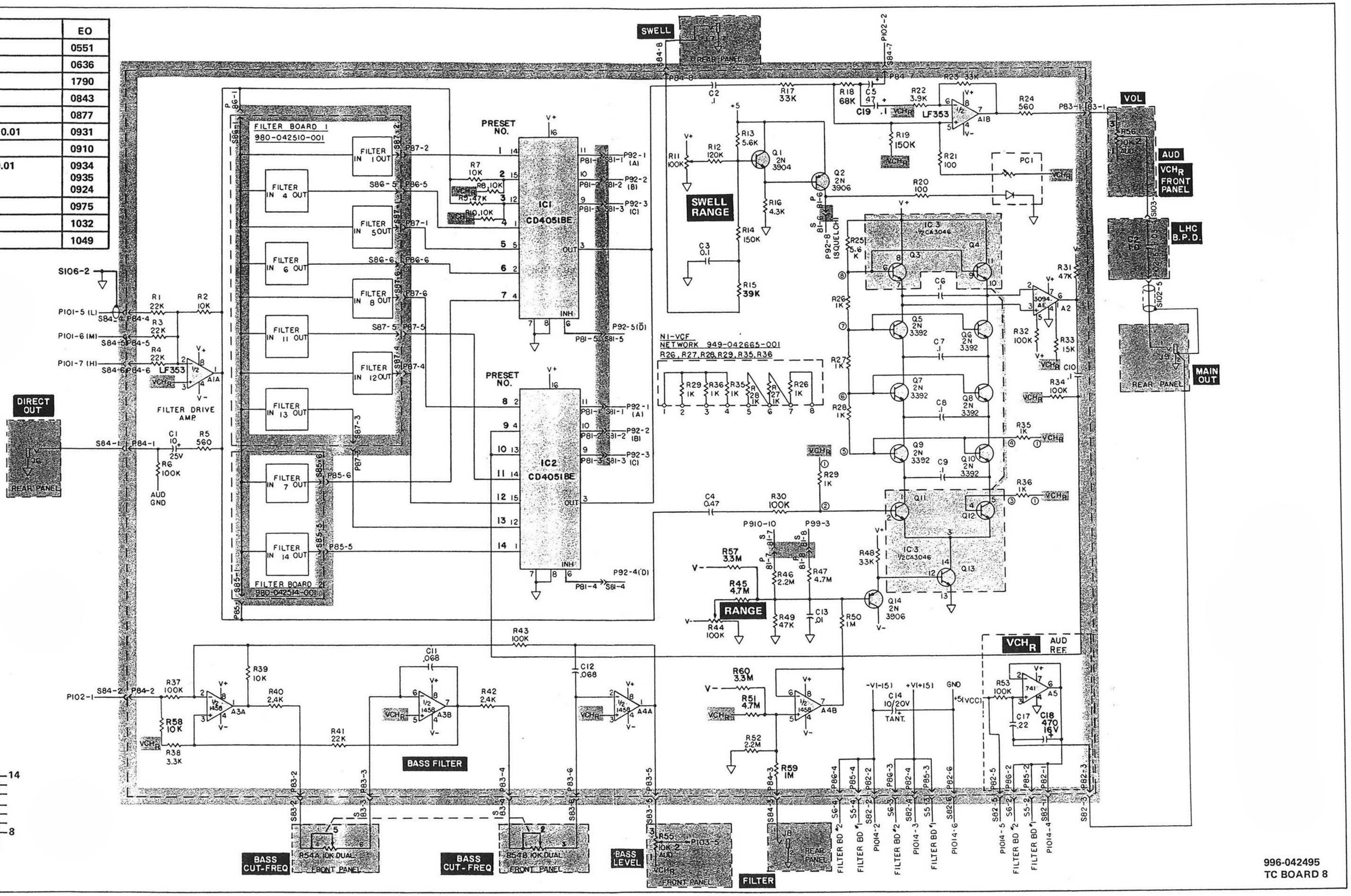
1
4

CA
MC

UDIO CIRCUIT SCHEMATIC DIAGRAM TC BOARD 8

1	2	3	4	5	6	7	14
8	9	10	11	12	13	14	

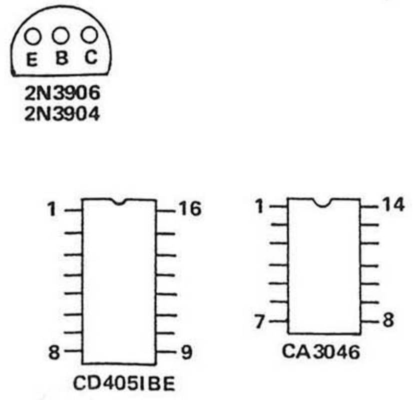
DESCRIPTION	EO
ED FOR PRODUCTION	0551
) IC2 CD4051BE WAS AE	0636
S LY WAS 981-042493	1790
3 WERE 100K, R19, R30 WERE 47K	0843
4558, IS TL082	0877
S 2.2M. ADDED R57, 3.3M AND C18, 0.01	0931
, R54 RENUMBERED	0910
R58 10K. A1 WAS TL082. C18 WAS 0.01	0934 0935 0924
R59, 1M	0975
S106-2	1032
C19, 0.1	1049


SWELL
REAR PANEL
VOL
AUD
VCHR FRONT PANEL
LHC B.P.D.
MAIN OUT
REAR PANEL
DIRECT OUT
REAR PANEL
S106-2
P101-5 (L)
P101-6 (M)
P101-7 (H)
R1 22K
R2 10K
R3 22K
R4 22K
LF353
1/2 A1A
FILTER DRIVE AMP.
C1 10 25V
R5 560
R6 100K
AUD GND
FILTER BOARD 1
980-042510-001
FILTER IN 1 OUT
FILTER IN 4 OUT
FILTER IN 5 OUT
FILTER IN 6 OUT
FILTER IN 8 OUT
FILTER IN 11 OUT
FILTER IN 12 OUT
FILTER IN 13 OUT
FILTER IN 7 OUT
FILTER IN 14 OUT
FILTER BOARD 2
980-042514-001
PRESET NO.
IC1 CD4051BE
IC2 CD4051BE
R7 10K
R8 10K
R9 47K
R10 10K
P92-1 (A)
P92-2 (B)
P92-3 (C)
P92-5 (D)
P92-4 (D)
C2 .1
R17 33K
R18 68K
C5 47
C19 .1
R22 3.9K
R23 33K
LF353 1/2 A1B
R24 560
R19 150K
R21 100
R20 100
PC1
R11 100K
R12 120K
R13 5.6K
Q1 2N3904
Q2 2N3906
R16 4.3K
R14 150K
R15 39K
C3 0.1
SWELL RANGE
P92-8 SQUELCH
N1-VCF NETWORK 949-042665-001
R26, R27, R28, R29, R35, R36
R29 1K
R36 1K
R35 1K
R28 1K
R27 1K
R26 1K
IC3 1/2 CA3046
Q3
Q4
R25 5.6K
C6 .1
Q5 2N3392
Q6 2N3392
C7 .1
Q7 2N3392
Q8 2N3392
C8 .1
Q9 2N3392
Q10 2N3392
C9 .1
Q11
Q12
Q13
R31 47K
3094 AE A2
R32 100K
R33 15K
C10 .1
R34 100K
R35 1K
R36 1K
R29 1K
C4 0.47
R30 100K
P910-10
P99-3
R57 3.3M
R45 4.7M
RANGE
R44 100K
R46 2.2M
R47 4.7M
R48 33K
R49 47K
C13 .01
R50 1M
Q14 2N3906
R43 100K
P102-1
R37 100K
1/2 1458 A3A
R39 10K
R40 2.4K
R58 10K
R38 3.3K
R41 22K
C11 .068
1/2 1458 A3B
R42 2.4K
BASS FILTER
C12 .068
1/2 1458 A4A
R60 3.3M
R51 4.7M
1/2 1458 A4B
R52 2.2M
R59 1M
-V(-15) +V(+15) GND
C14 10/20V TANT.
+5(VCC)
VCHR AUD REF.
R53 100K
741 A5
C17 .22
C18 470 16V
R54A 10K DUAL
FRONT PANEL
BASS CUT-FREQ
R54B 10K DUAL
FRONT PANEL
BASS CUT-FREQ
R55 10K
P103-5
AUD
VCHR
FRONT PANEL
BASS LEVEL
J8
REAR PANEL
FILTER
FILTER BD #2
FILTER BD #1
P104-2
P104-3
P104-6
P104-5
P104-4

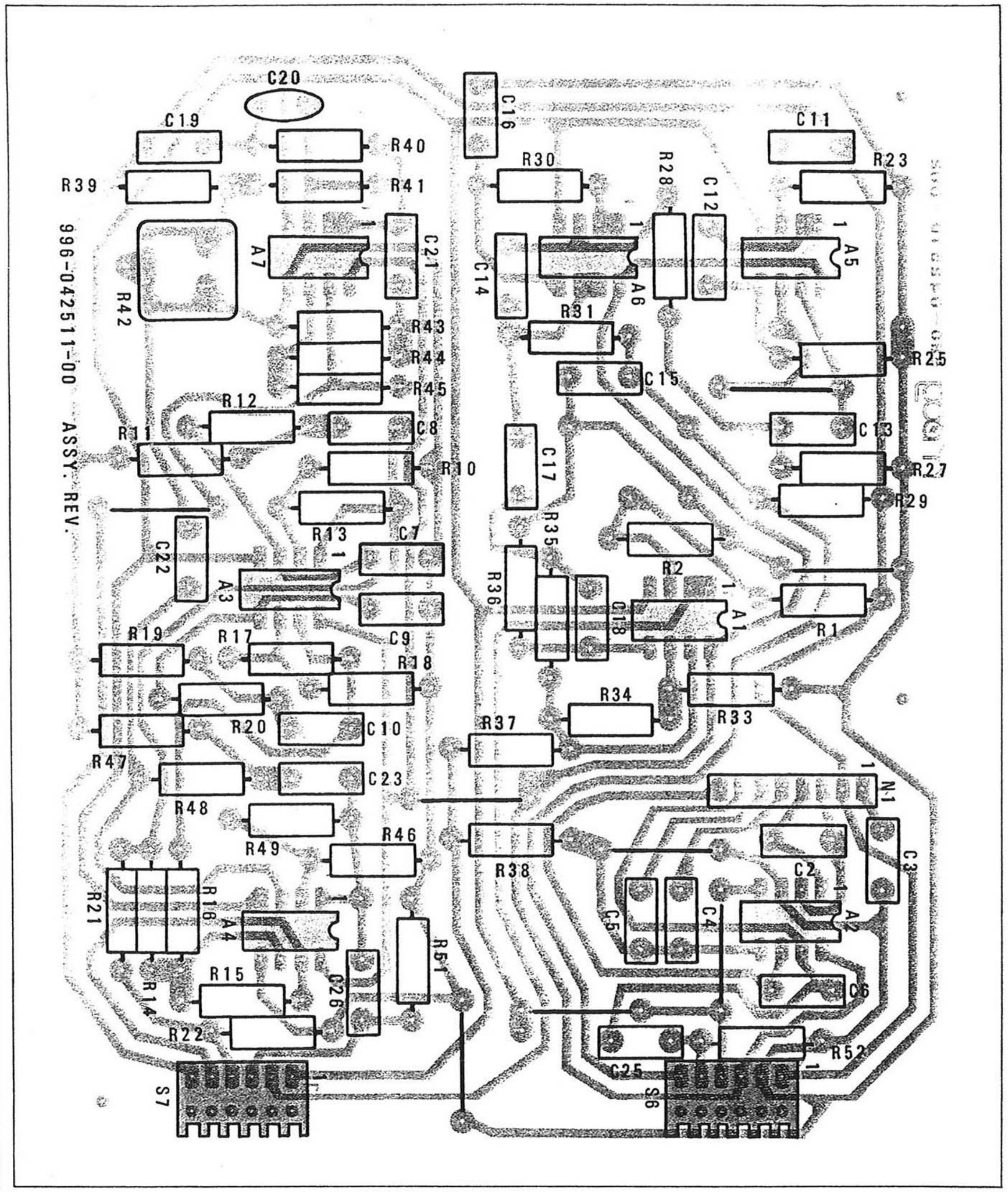
L ACEMENT PARTS
ME 1, SECTION 5 FOR
MBER AND DESCRIPTION
ERENCE DESIGNATOR.

ERWISE SPECIFIED —
STORS ARE IN OHMS 1/4W, ±5%.
CITORS ARE IN MFD (uf).

MPONENT BASING
(TOP VIEW)


E B C
2N3906
2N3904
1
16
8
9
CD4051BE
1
14
7
8
CA3046

996-042495
TC BOARD 8


C20
C19
R40
R39
R41
C16
C11
R30
R28
C12
R23
996-042511-00 ASSY. REV.
A7
C21
R42
C14
A6
A5
R31
R43
R44
R45
C15
R25
R12
C8
C13
R11
R10
R27
C17
R29
R13
C7
C22
A3
R36
R35
R2
A1
C9
C18
R19
R17
R18
R1
R34
R33
R20
C10
R37
R47
C23
N1
R48
R46
R49
R38
C3
R21
R16
C2
A4
C5
C4
A2
R51
R15
C26
C6
R14
R22
R52
C25
S7
S6

REV	DESCRIPTION	EO
A	RELEASED FOR PRODUCTION	0551
B	NEXT ASSEMBLY WAS 981-042500	0790
C	ADDED S141	0835
D	JUMPER REMOVED. ADDED R24,R26,10K. R15 WAS 4.7K	0843

REV	DESCRIPTION	EO
E	ADDED R52, 10K AND C25, 0.033	0931
F	REMOVED R50, 10K. ADDED C26 0.03%. R37, 10K WAS JUMPER. R38, 10K WAS OPEN	0924
G	FILTER NO. 1 WAS STRING SOLO	1101
H	R10,R13,R17,R18 WERE 5%	1173A

REF DES	VALUE
R15	2.4K
R21	100K
R22	4.7K
R24	10K
R26	10K
R32	OPEN
R37	10K
R38	10K
R45	10K
R51	10K

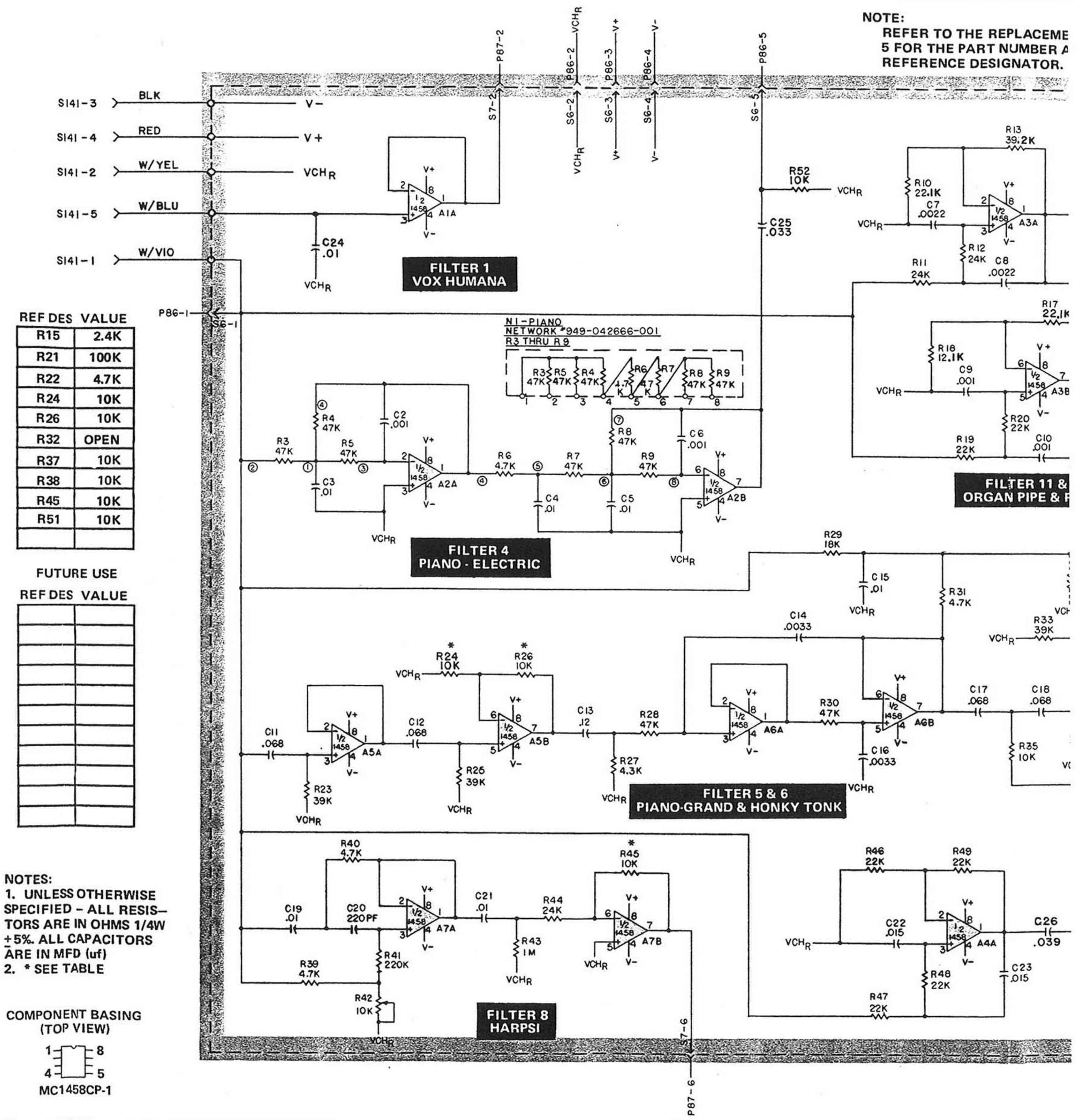
FUTURE USE

REF DES	VALUE

NOTES:
1. UNLESS OTHERWISE SPECIFIED – ALL RESISTORS ARE IN OHMS 1/4W ±5%. ALL CAPACITORS ARE IN MFD (uf)
2. * SEE TABLE

COMPONENT BASING
(TOP VIEW)

MC1458CP-1

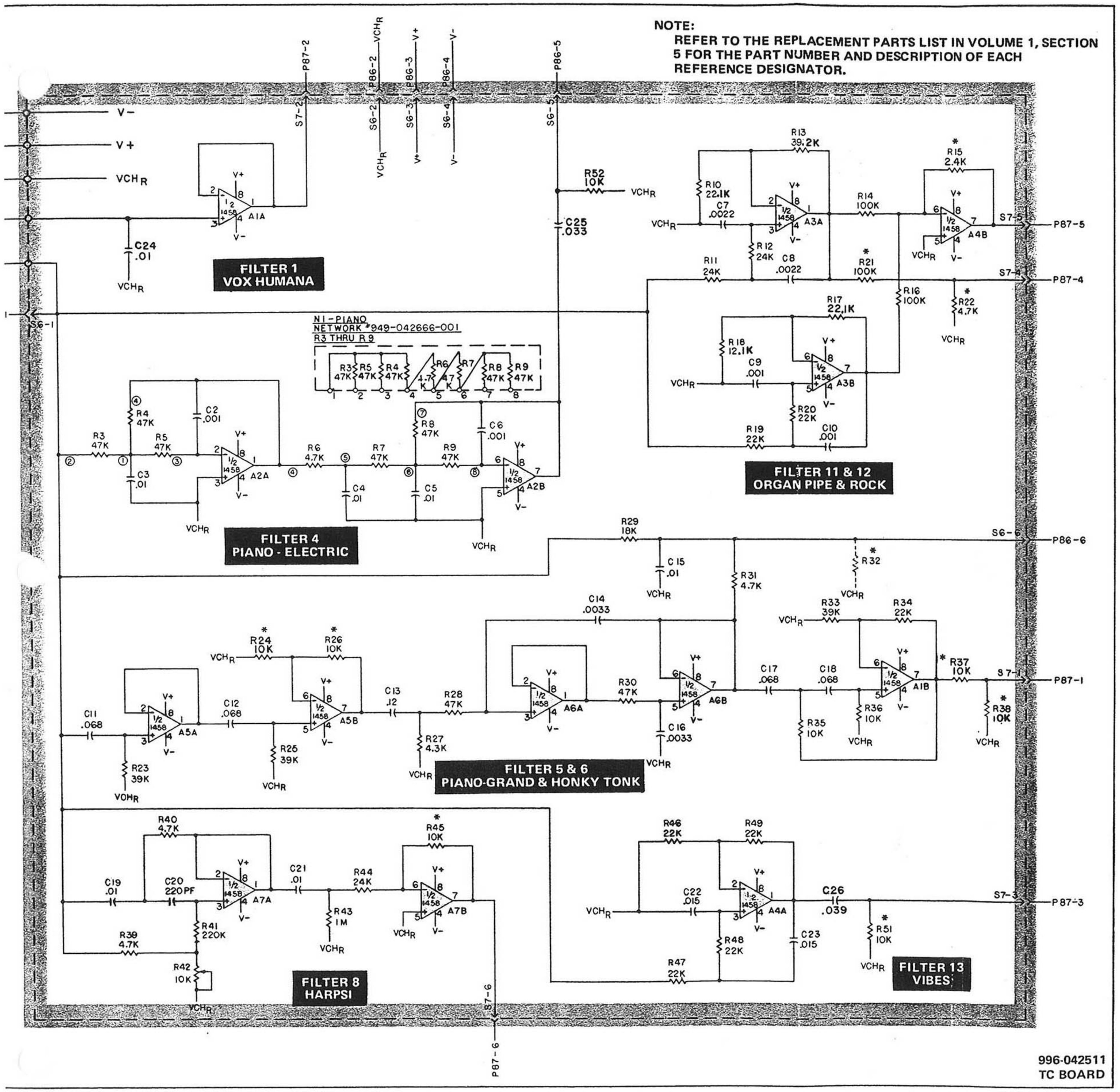


NOTE:
REFER TO THE REPLACEME
5 FOR THE PART NUMBER A
REFERENCE DESIGNATOR.

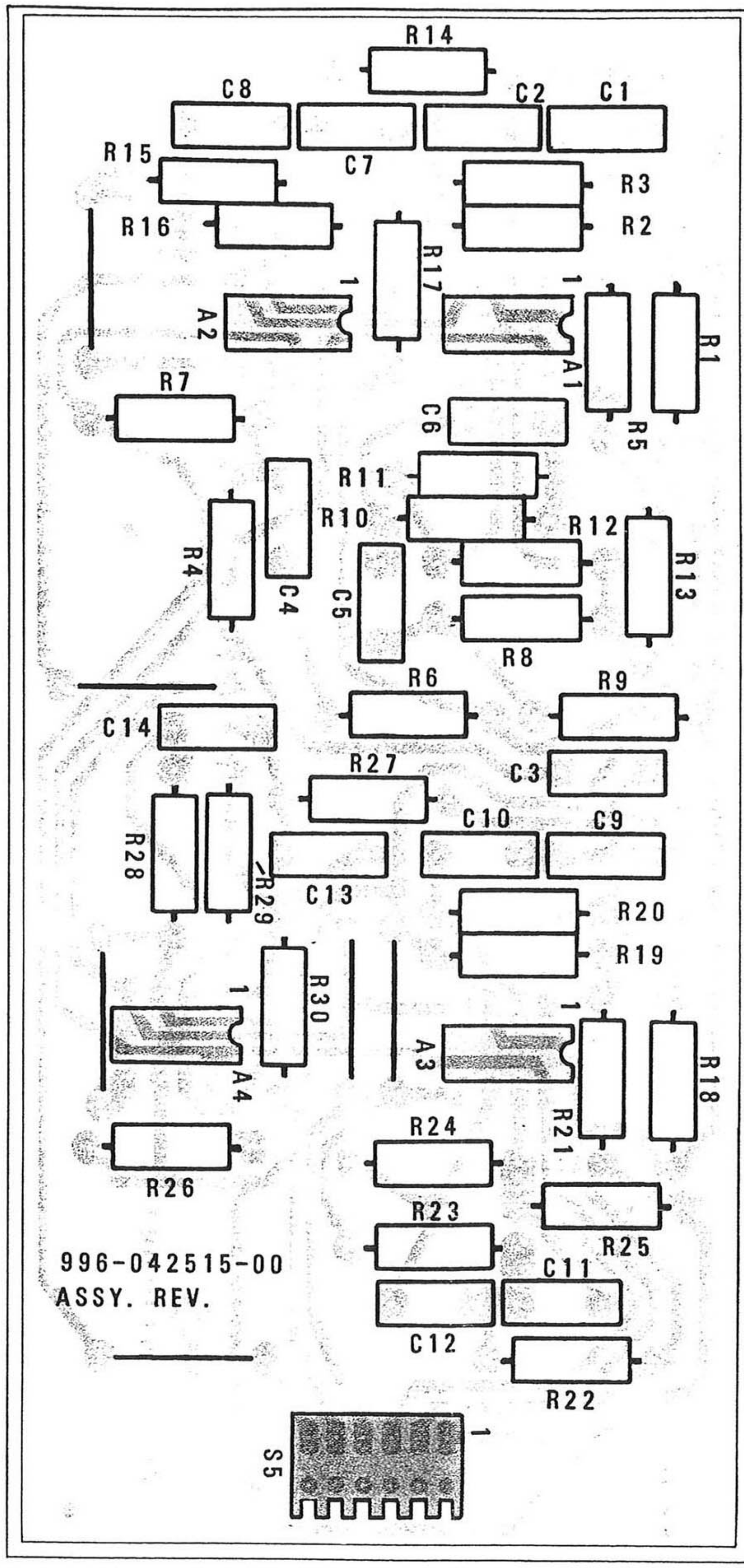
S141-3
BLK
V−
S141-4
RED
V+
S141-2
W/YEL
VCHR
S141-5
W/BLU
S141-1
W/VIO
P86-1
S6-1
P87-2
S7-2
P86-2
S6-2
VCHR
P86-3
S6-3
V+
P86-4
S6-4
V−
P86-5
S6-5
C24
.01
VCHR
A1A
1/2 1458
FILTER 1
VOX HUMANA
R52
10K
C25
.033
R13
39.2K
R10
22.1K
C7
.0022
A3A
R12
24K
C8
.0022
R11
24K
R17
22.1K
R18
12.1K
C9
.001
A3B
R20
22K
R19
22K
C10
.001
FILTER 11 &
ORGAN PIPE & F
N1-PIANO
NETWORK *949-042666-001
R3 THRU R9
R3 47K
R5 47K
R4 47K
R6 4.7K
R7 47K
R8 47K
R9 47K
R4
47K
C2
.001
R3
47K
R5
47K
C3
.01
A2A
R6
4.7K
R7
47K
C4
.01
C5
.01
R8
47K
C6
.001
R9
47K
A2B
FILTER 4
PIANO - ELECTRIC
R29
18K
C15
.01
R31
4.7K
R33
39K
C14
.0033
R24
10K
R26
10K
C11
.068
A5A
C12
.068
A5B
R23
39K
R25
39K
C13
.12
R28
47K
R27
4.3K
A6A
R30
47K
A6B
C16
.0033
C17
.068
C18
.068
R35
10K
FILTER 5 & 6
PIANO-GRAND & HONKY TONK
R40
4.7K
R45
10K
C19
.01
C20
220PF
A7A
C21
.01
R44
24K
A7B
R43
1M
R41
220K
R39
4.7K
R42
10K
FILTER 8
HARPSI
P87-6
S7-6
R46
22K
R49
22K
C22
.015
A4A
C26
.039
R48
22K
C23
.015
R47
22K

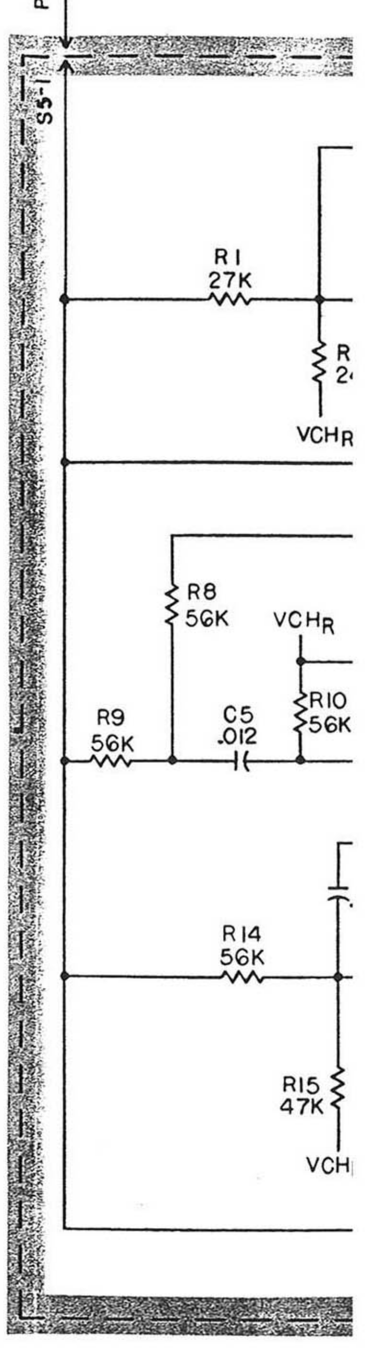
FILTER TC BOARD NO. 1 SCHEMATIC DIAGRAM

NOTE:
REFER TO THE REPLACEMENT PARTS LIST IN VOLUME 1, SECTION 5 FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.


P87-2
VCHR
V+
V-
P86-2
P86-3
P86-4
P86-5
S7-2
S6-2
S6-3
S6-4
S6-5
V-
V+
VCHR
A1A
C24 .01
FILTER 1 VOX HUMANA
R52 10K
C25 .033
R13 39.2K
R10 22.1K
C7 .0022
A3A
R12 24K
C8 .0022
R11 24K
R14 100K
R15 2.4K
A4B
S7-5
P87-5
R21 100K
S7-4
P87-4
R16 100K
R22 4.7K
S6-1
N1-PIANO NETWORK *949-042666-001 R3 THRU R9
R3 47K
R5 47K
R4 47K
R6 4.7K
R7 47K
R8 47K
R9 47K
R17 22.1K
R18 12.1K
C9 .001
A3B
R20 22K
R19 22K
C10 .001
FILTER 11 & 12 ORGAN PIPE & ROCK
R4 47K
C2 .001
R3 47K
R5 47K
C3 .01
A2A
R6 4.7K
C4 .01
R7 47K
R8 47K
C6 .001
R9 47K
C5 .01
A2B
FILTER 4 PIANO - ELECTRIC
R29 18K
C15 .01
R31 4.7K
R32
S6-6
P86-6
C14 .0033
R33 39K
R34 22K
R24 10K
R26 10K
C11 .068
A5A
C12 .068
A5B
C13 .12
R28 47K
A6A
R30 47K
A6B
C16 .0033
C17 .068
C18 .068
A1B
R37 10K
S7-1
P87-1
R38 10K
R35 10K
R36 10K
R23 39K
R25 39K
R27 4.3K
FILTER 5 & 6 PIANO-GRAND & HONKY TONK
R40 4.7K
R45 10K
R46 22K
R49 22K
C19 .01
C20 220PF
A7A
C21 .01
R44 24K
A7B
R43 1M
R39 4.7K
R41 220K
R42 10K
C22 .015
A4A
C26 .039
S7-3
P87-3
R48 22K
C23 .015
R51 10K
R47 22K
FILTER 8 HARPSI
FILTER 13 VIBES
S7-6
P87-6
1/2 1458

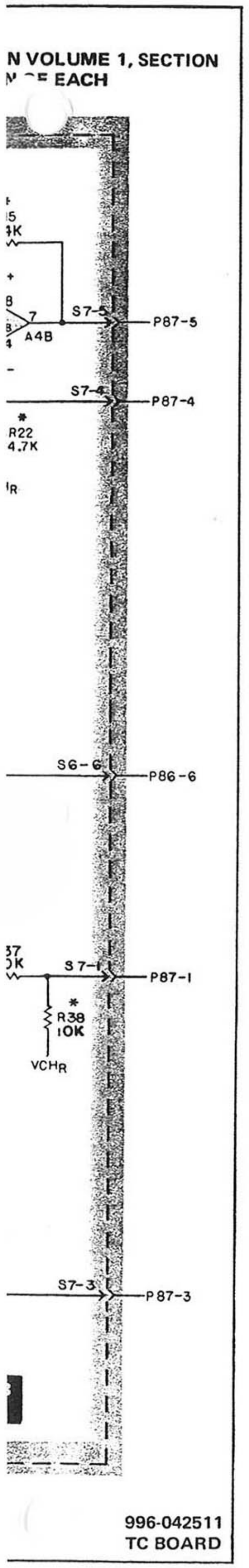
996-042511
TC BOARD


R14
C8
C2
C1
C7
R15
R3
R16
R2
R17
A2
A1
R1
R5
R7
C6
R11
R10
R12
R4
C4
C5
R13
R8
R6
R9
C14
R27
C3
C10
C9
R28
R29
C13
R20
R19
R30
A4
A3
R21
R18
R24
R26
R23
R25
C11
C12
R22
S5
1
996-042515-00
ASSY. REV.

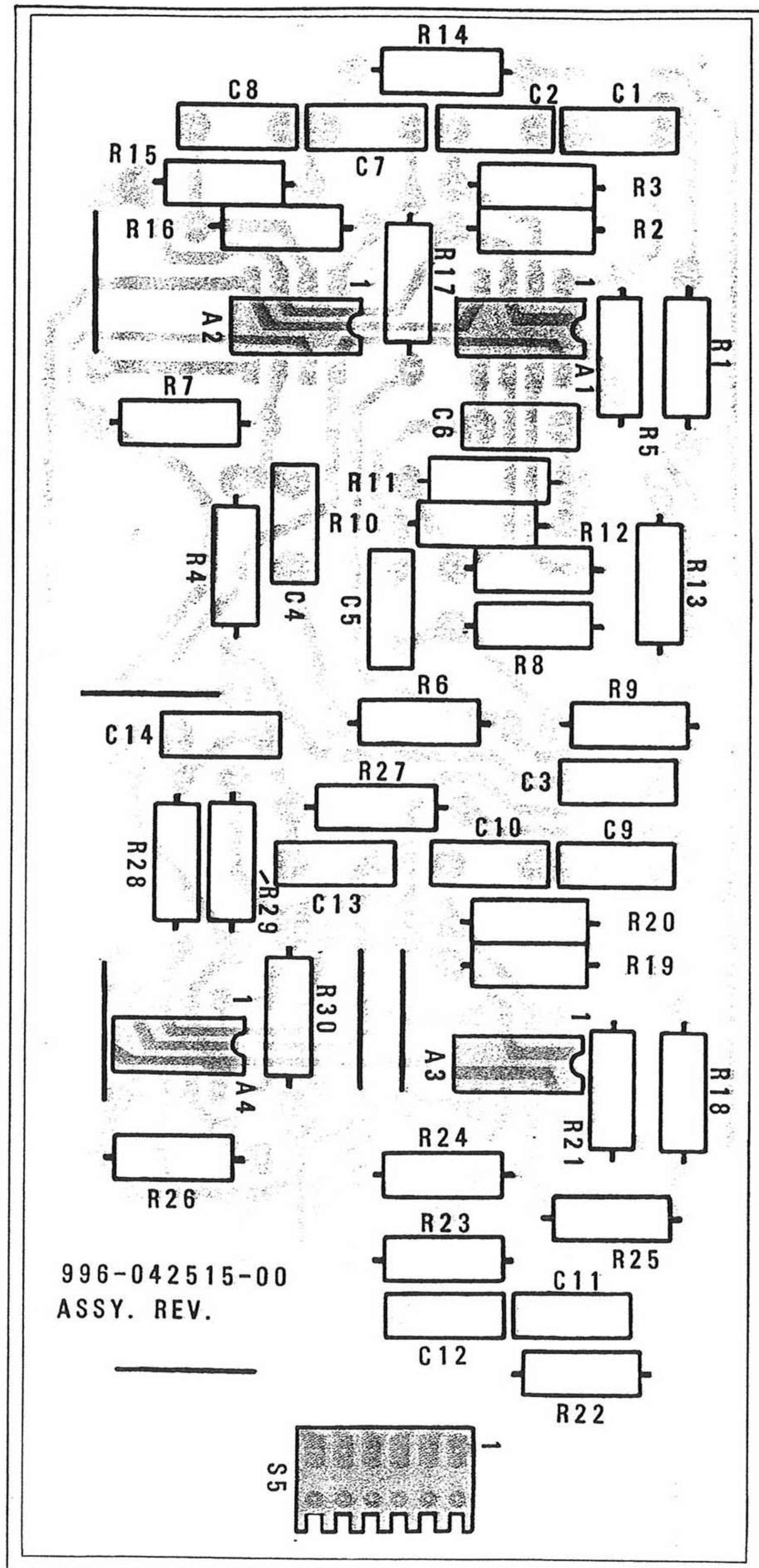

P85-1
S5-1
R1 27K
VCHR
R8 56K
VCHR
R10 56K
R9 56K
C5 .012
R14 56K
R15 47K

REV	DES
A	RELEASED FOR PROD
B	NEXT ASSEMBLY WAS
C	R7 WAS 33K; R26 WAS

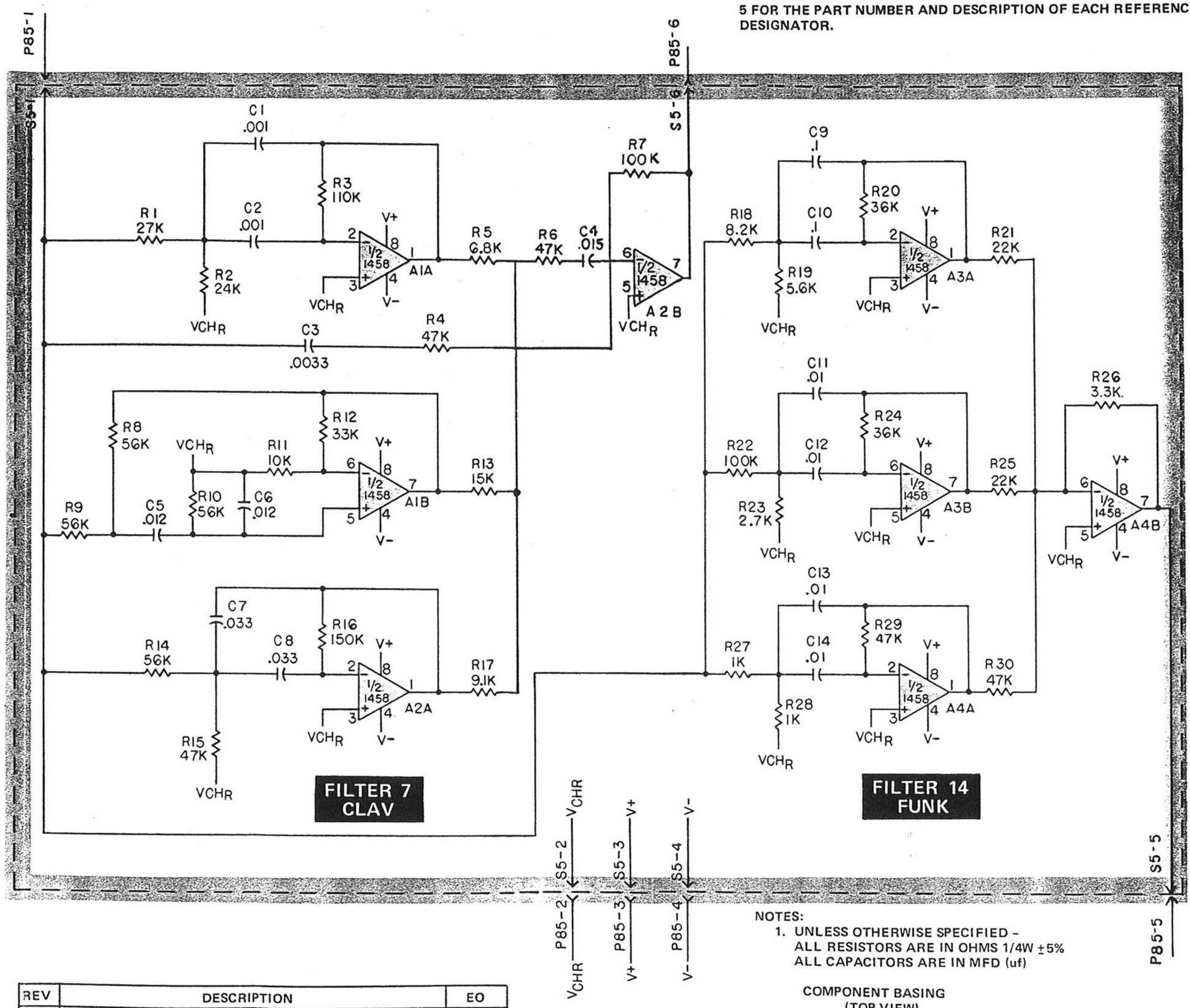
RD NO. 1 SCHEMATIC DIAGRAM


N VOLUME 1, SECTION
N OF EACH
S7-5
P87-5
A4B
S7-4
P87-4
R22
4.7K
S6-6
P86-6
S7-1
P87-1
R38
10K
VCHR
S7-3
P87-3

996-042511
TC BOARD

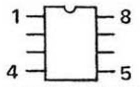

R14
C8
C2
C1
C7
R15
R3
R16
R2
R17
A2
A1
R1
R7
C6
R5
R11
R10
R12
R4
C4
C5
R13
R8
R6
R9
C14
R27
C3
C10
C9
R28
R29
C13
R20
R19
R30
A4
A3
R21
R18
R24
R26
R23
R25
C11
C12
R22
S5
996-042515-00
ASSY. REV.

NOTE:
REFER TO THE REPLACEMENT PARTS LIST IN VOLUME 1, SECTION 5 FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.


P85-1
S5-1
P85-6
S5-6
C1 .001
R3 110K
R1 27K
C2 .001
R2 24K
VCHR
V+
1/2 1458
A1A
V-
R5 6.8K
R6 47K
C4 .015
R7 100K
1/2 1458
A2B
C3 .0033
R4 47K
R8 56K
VCHR
R11 10K
R12 33K
R9 56K
C5 .012
R10 56K
C6 .012
1/2 1458
A1B
R13 15K
C7 .033
R16 150K
R14 56K
C8 .033
1/2 1458
A2A
R17 9.1K
R15 47K
FILTER 7 CLAV
C9 .1
R20 36K
R18 8.2K
C10 .1
R19 5.6K
1/2 1458
A3A
R21 22K
C11 .01
R24 36K
R22 100K
C12 .01
R23 2.7K
1/2 1458
A3B
R25 22K
R26 3.3K
1/2 1458
A4B
C13 .01
R29 47K
R27 1K
C14 .01
R28 1K
1/2 1458
A4A
R30 47K
FILTER 14 FUNK
VCHR
S5-2
P85-2
V+
S5-3
P85-3
V-
S5-4
P85-4
S5-5
P85-5

NOTES:
1. UNLESS OTHERWISE SPECIFIED -
ALL RESISTORS ARE IN OHMS 1/4W ±5%
ALL CAPACITORS ARE IN MFD (uf)

COMPONENT BASING
(TOP VIEW)

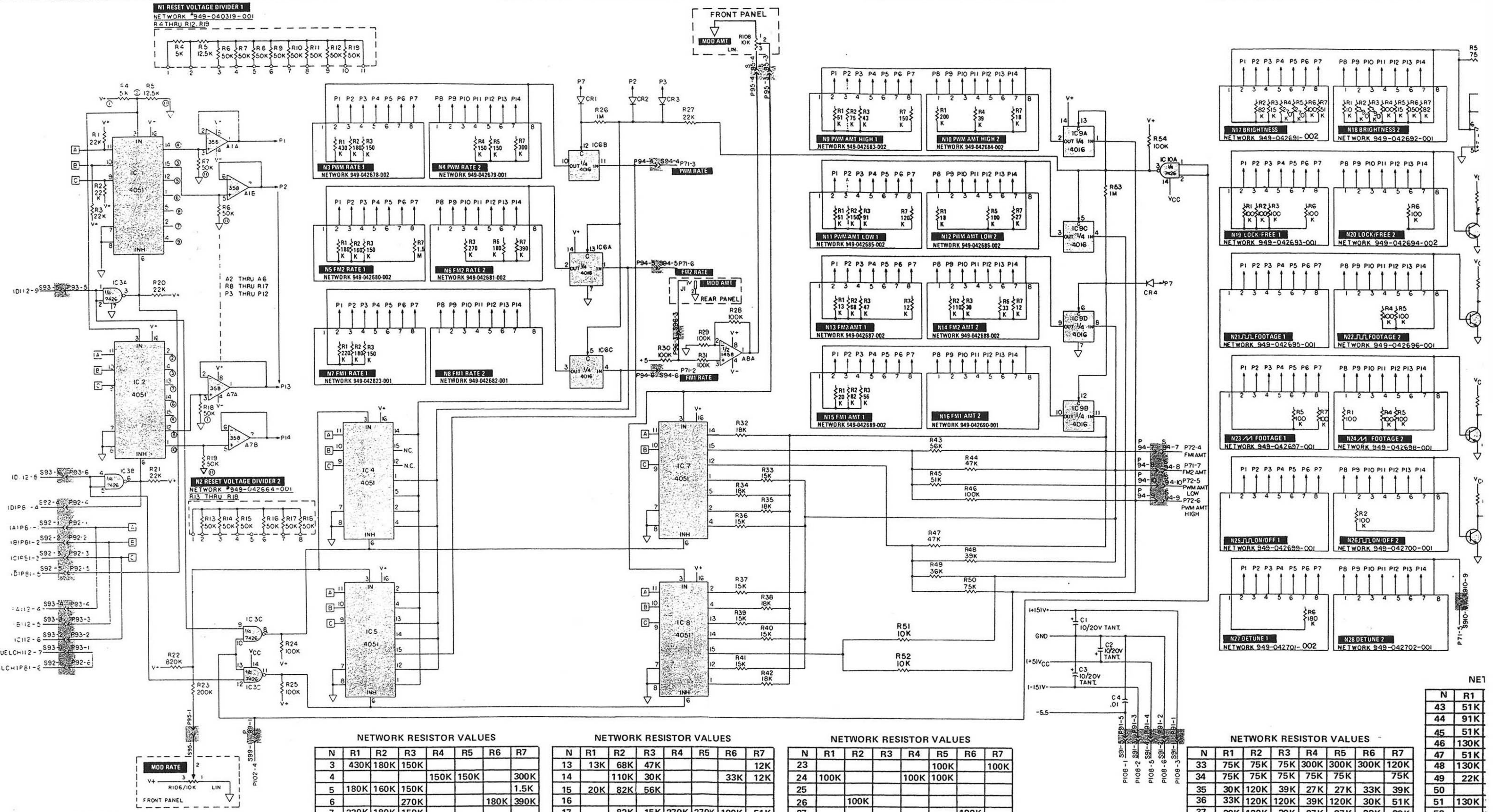


MC1458CP-1

REV	DESCRIPTION	EO
A	RELEASED FOR PRODUCTION	0551
B	NEXT ASSEMBLY WAS 981-042513	0790
C	R7 WAS 33K; R26 WAS 7.5K	0843

996-042515
TC BOARD

FILTER TC BOARD NO. 2 SCHEMATIC DIAGRAM


N1 RESET VOLTAGE DIVIDER 1
NETWORK #949-040319-001
R4 THRU R12, R19
N2 RESET VOLTAGE DIVIDER 2
NETWORK #949-042664-001
R13 THRU R18
IC 1 4051
IC 2 4051
IC 4 4051
IC 5 4051
IC 7 4051
IC 8 4051
IC6A 1/4 4016
IC6B 1/4 4016
IC6C 1/4 4016
IC9A 1/4 4016
IC9B 1/4 4016
IC9C 1/4 4016
IC9D 1/4 4016
IC10A 1/4 7426
IC3A 1/4 7426
IC3B 1/4 7426
IC3C 1/4 7426
IC3D 1/4 7426
A1A 358
A1B 358
A7A 358
A7B 358
A8A 1/2 1458
A2 THRU A6
R8 THRU R17
P3 THRU P12
FRONT PANEL
MOD AMT
R108 10K LIN.
REAR PANEL
MOD RATE
R106/10K LIN
PWM RATE
FM2 RATE
FM1 RATE
N3 PWM RATE 1 NETWORK 949-042678-002
N4 PWM RATE 2 NETWORK 949-042679-001
N5 FM2 RATE 1 NETWORK 949-042680-002
N6 FM2 RATE 2 NETWORK 949-042681-002
N7 FM1 RATE 1 NETWORK 949-042823-001
N8 FM1 RATE 2 NETWORK 949-042682-001
N9 PWM AMT HIGH 1 NETWORK 949-042683-002
N10 PWM AMT HIGH 2 NETWORK 949-042684-002
N11 PWM AMT LOW 1 NETWORK 949-042685-002
N12 PWM AMT LOW 2 NETWORK 949-042686-002
N13 FM2 AMT 1 NETWORK 949-042687-002
N14 FM2 AMT 2 NETWORK 949-042688-002
N15 FM1 AMT 1 NETWORK 949-042689-002
N16 FM1 AMT 2 NETWORK 949-042690-001
N17 BRIGHTNESS NETWORK 949-042691-002
N18 BRIGHTNESS 2 NETWORK 949-042692-001
N19 LOCK/FREE 1 NETWORK 949-042693-001
N20 LOCK/FREE 2 NETWORK 949-042694-002
N21 FOOTAGE 1 NETWORK 949-042695-001
N22 FOOTAGE 2 NETWORK 949-042696-001
N23 FOOTAGE 1 NETWORK 949-042697-001
N24 FOOTAGE 2 NETWORK 949-042698-001
N25 ON/OFF 1 NETWORK 949-042699-001
N26 ON/OFF 2 NETWORK 949-042700-001
N27 DETUNE 1 NETWORK 949-042701-002
N28 DETUNE 2 NETWORK 949-042702-001
P72-4 FM1 AMT
P72-7 FM2 AMT
P72-5 PWM AMT LOW
P72-6 PWM AMT HIGH
C1 10/20V TANT.
C2 10/20V TANT.
C3 10/20V TANT.
C4 .01
(+15)V
GND
(+5)VCC
(-15)V
-5.5

NETWORK RESISTOR VALUES

N	R4	R5	R6	R7	R8	R9	R10	R11	R12	R19
1	5 K	12.5K	50K	50K	50K	50K	50K	50K	50K	50K
2	R13	R14	R15	R16	R17	R18				
	50K	50K	50K	50K	50K	50K				

NETWORK RESISTOR VALUES

N	R1	R2	R3	R4	R5	R6	R7
3	430K	180K	150K				
4				150K	150K		300K
5	180K	160K	150K				1.5K
6			270K			180K	390K
7	220K	180K	150K				
8							
9	51K	75K	43K				150K
10	200K				39K		18K
11	51K	150K	91K				120K
12	18K				100K		27K

NETWORK RESISTOR VALUES

N	R1	R2	R3	R4	R5	R6	R7
13	13K	68K	47K				12K
14		110K	30K			33K	12K
15	20K	82K	56K				
16							
17		82K	15K	270K	270K	100K	51K
18	10K	390K	390K	100K	15K	150K	82K
19	100K	100K	100K			100K	
20						100K	
21							
22				100K	100K		

NETWORK RESISTOR VALUES

N	R1	R2	R3	R4	R5	R6	R7
23					100K		100K
24	100K			100K	100K		
25							
26		100K					
27						180K	
28							
29	22K	75K	30K	33K	22K	27K	33K
30	12K	15K	15K	15K	33K		24K
31	22K	30K	30K	33K	30K	27K	33K
32	12K	15K	15K	15K	15K		24K

NETWORK RESISTOR VALUES

N	R1	R2	R3	R4	R5	R6	R7
33	75K	75K	75K	300K	300K	300K	120K
34	75K	75K	75K	75K	75K		75K
35	30K	120K	39K	27K	27K	33K	39K
36	33K	120K	120K	39K	120K	30K	51K
37	30K	120K	39K	27K	27K	33K	39K
38	33K	120K	120K	39K	120K	30K	51K
39		150K		75K	130K	130K	130K
40	24K	130K	130K			100K	24K
41	200K	150K	130K				
42		100K	100K	100K	150K		240K

NET

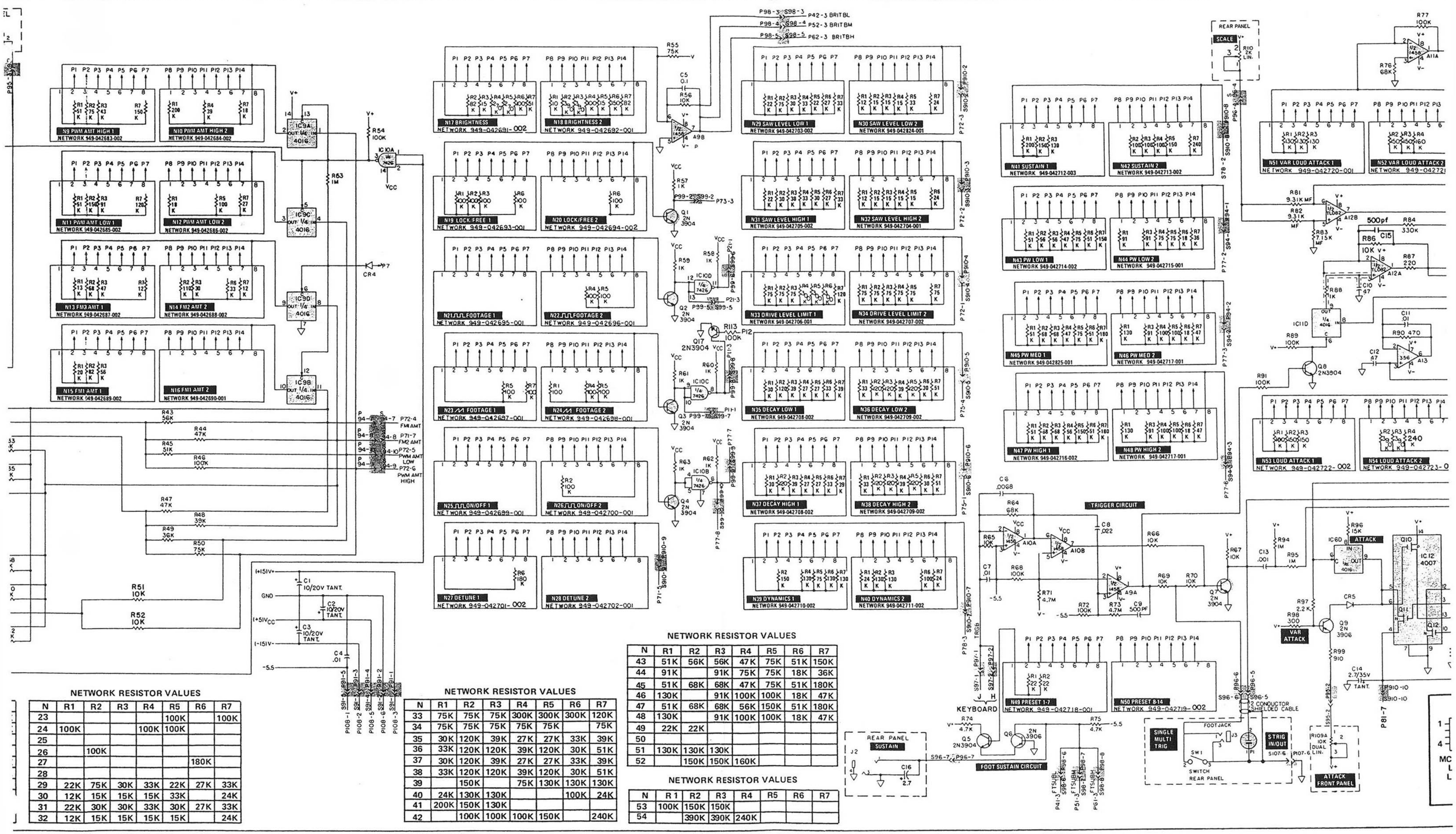
N	R1
43	51K
44	91K
45	51K
46	130K
47	51K
48	130K
49	22K
50	
51	130K
52	

NET

N	R1
53	100K
54	

OGRAM CONTROL SCHEMATIC DIAGRAM TR BOARD 9

1	2	3	4	5	6	7	14
8	9	10	11	12	13	14	


N9 PWM AMT HIGH 1
NETWORK 949-042683-002
N10 PWM AMT HIGH 2
NETWORK 949-042684-002
N11 PWM AMT LOW 1
NETWORK 949-042685-002
N12 PWM AMT LOW 2
NETWORK 949-042686-002
N13 FM2 AMT 1
NETWORK 949-042687-002
N14 FM2 AMT 2
NETWORK 949-042688-002
N15 FM1 AMT 1
NETWORK 949-042689-002
N16 FM1 AMT 2
NETWORK 949-042690-001
IC9A 1/4 4016
IC9C 1/4 4016
IC9D 1/4 4016
IC9B 1/4 4016
IC10A 7426
R54 100K
R63 1M
CR4
N17 BRIGHTNESS
NETWORK 949-042691-002
N18 BRIGHTNESS 2
NETWORK 949-042692-001
N19 LOCK/FREE 1
NETWORK 949-042693-001
N20 LOCK/FREE 2
NETWORK 949-042694-002
N21 FOOTAGE 1
NETWORK 949-042695-001
N22 FOOTAGE 2
NETWORK 949-042696-001
N23 FOOTAGE 1
NETWORK 949-042697-001
N24 FOOTAGE 2
NETWORK 949-042698-001
N25 ON/OFF 1
NETWORK 949-042699-001
N26 ON/OFF 2
NETWORK 949-042700-001
N27 DETUNE 1
NETWORK 949-042701-002
N28 DETUNE 2
NETWORK 949-042702-001
R55 75K
C5 0.1
R56 10K
1/2 1458 A9B
P98-3 S98-3 P42-3 BRITBL
P98-4 S98-4 P52-3 BRITBM
P98-5 S98-5 P62-3 BRITBH
Q1 2N3904
Q2 2N3904
Q3 2N3904
Q4 2N3904
Q17 2N3904
R113 100K
IC10D 1/4 7426
IC10C 1/4 7426
IC10B 1/4 7426
N29 SAW LEVEL LOW 1
NETWORK 949-042703-002
N30 SAW LEVEL LOW 2
NETWORK 949-042824-001
N31 SAW LEVEL HIGH 1
NETWORK 949-042705-002
N32 SAW LEVEL HIGH 2
NETWORK 949-042704-001
N33 DRIVE LEVEL LIMIT 1
NETWORK 949-042706-001
N34 DRIVE LEVEL LIMIT 2
NETWORK 949-042707-002
N35 DECAY LOW 1
NETWORK 949-042708-002
N36 DECAY LOW 2
NETWORK 949-042709-002
N37 DECAY HIGH 1
NETWORK 949-042708-002
N38 DECAY HIGH 2
NETWORK 949-042709-002
N39 DYNAMICS 1
NETWORK 949-042710-002
N40 DYNAMICS 2
NETWORK 949-042711-002
N41 SUSTAIN 1
NETWORK 949-042712-003
N42 SUSTAIN 2
NETWORK 949-042713-002
N43 PW LOW 1
NETWORK 949-042714-002
N44 PW LOW 2
NETWORK 949-042715-001
N45 PW MED 1
NETWORK 949-042825-001
N46 PW MED 2
NETWORK 949-042717-001
N47 PW HIGH 1
NETWORK 949-042716-002
N48 PW HIGH 2
NETWORK 949-042717-001
N49 PRESET 1-7
NETWORK 949-042718-001
N50 PRESET 8-14
NETWORK 949-042719-002
N51 VAR LOUD ATTACK 1
NETWORK 949-042720-001
N52 VAR LOUD ATTACK 2
N53 LOUD ATTACK 1
NETWORK 949-042722-002
N54 LOUD ATTACK 2
NETWORK 949-042723-0
REAR PANEL
SCALE
R110 2K LIN.
R77 100K
R76 68K
1/2 1458 A11A
R81 9.31K MF
R82 9.31K MF
R83 7.15K MF
1/2 TL082 A12B
500pf
R84 330K
R86 10K
C15
1/2 TL082 A12A
R87 220
R88 1K
C10 47
IC11D 4016
C11 .01
R90 470
R89 100K
C12 47
356 A13
R91 100K
Q8 2N3904
TRIGGER CIRCUIT
C6 .0068
R64 68K
R65 10K
1/2 1458 A10A
1/2 1458 A10B
C8 .022
C7 .01
R68 100K
R71 4.7M
R66 10K
1/2 1458 A9A
R69 10K
R70 10K
R72 100K
R73 4.7M
C9 500PF
R67 10K
Q7 2N3904
R94 1M
C13 .001
R95 1M
R96 15K
IC6D 4016
ATTACK
Q10
IC12 4007
Q11
Q12
R97 2.2K
R98 300
VAR ATTACK
Q9 2N3906
CR5
R99 910
C14 2.7/35V TANT.
KEYBOARD
R74 4.7K
Q5 2N3904
Q6 2N3906
R75 4.7K
FOOT SUSTAIN CIRCUIT
REAR PANEL
SUSTAIN
J2
C16 2.7
FTSUBL
FTSUBM
FTSUBH
SINGLE MULTI TRIG
FOOTJACK
J3
SW1
SWITCH REAR PANEL
2 CONDUCTOR SHIELDED CABLE
STRIG IN/OUT
R109A 10K DUAL LIN.
ATTACK FRONT PANEL
R43 56K
R44 47K
R45 51K
R46 100K
R47 47K
R48 39K
R49 36K
R50 75K
R51 10K
R52 10K
P72-4 FM1 AMT
P71-7 FM2 AMT
P72-5 PWM AMT LOW
P72-6 PWM AMT HIGH
(+15)V+
C1 10/20V TANT.
GND
C2 10/20V TANT.
(+5)VCC
C3 10/20V TANT.
(-15)V-
C4 .01
-5.5

NETWORK RESISTOR VALUES

N	R1	R2	R3	R4	R5	R6	R7
23					100K		100K
24	100K			100K	100K		
25							
26		100K					
27						180K	
28							
29	22K	75K	30K	33K	22K	27K	33K
30	12K	15K	15K	15K	33K		24K
31	22K	30K	30K	33K	30K	27K	33K
32	12K	15K	15K	15K	15K		24K

NETWORK RESISTOR VALUES

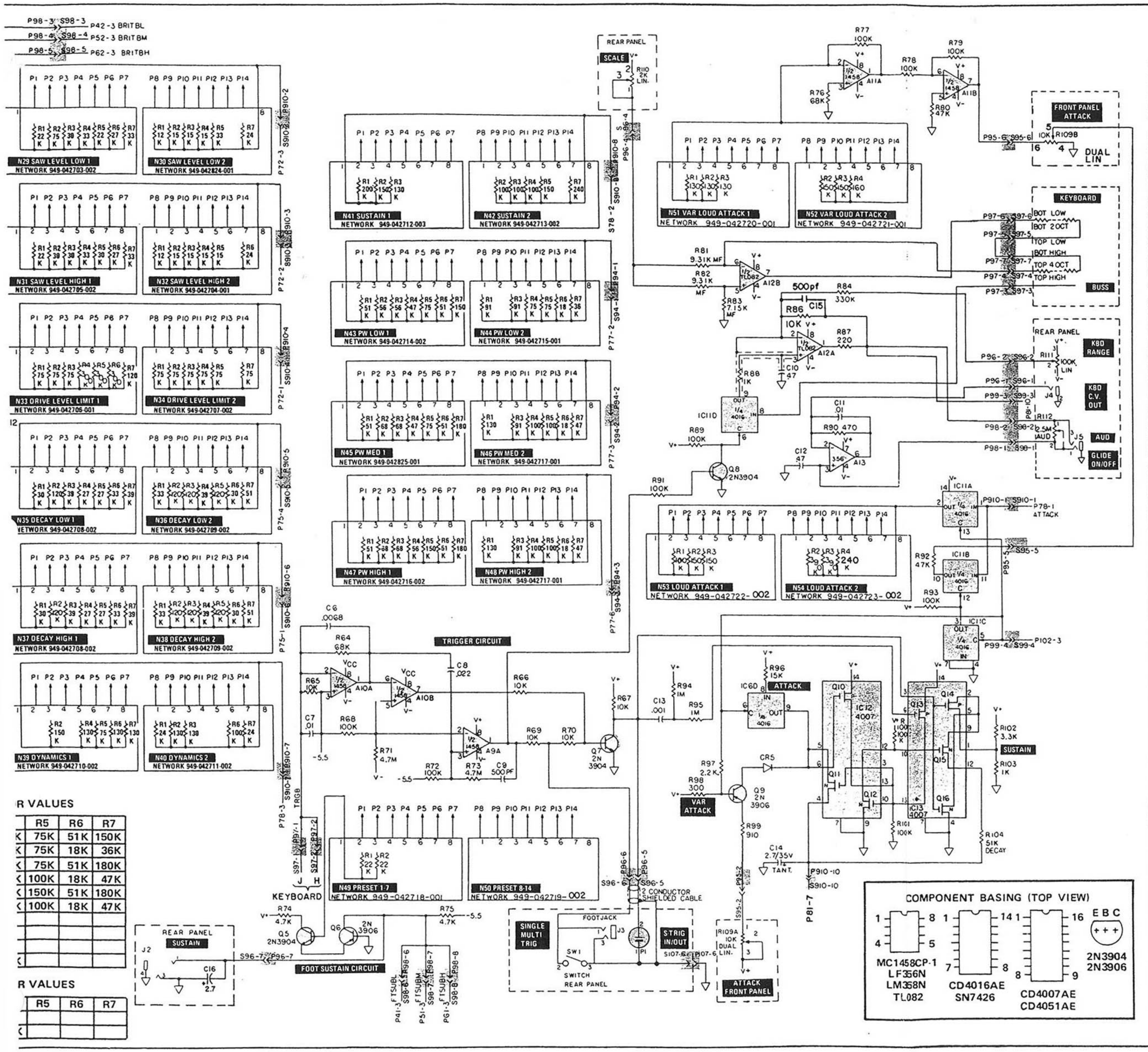
N	R1	R2	R3	R4	R5	R6	R7
33	75K	75K	75K	300K	300K	300K	120K
34	75K	75K	75K	75K	75K		75K
35	30K	120K	39K	27K	27K	33K	39K
36	33K	120K	120K	39K	120K	30K	51K
37	30K	120K	39K	27K	27K	33K	39K
38	33K	120K	120K	39K	120K	30K	51K
39		150K		75K	130K	130K	130K
40	24K	130K	130K			100K	24K
41	200K	150K	130K				
42		100K	100K	100K	150K		240K

NETWORK RESISTOR VALUES

N	R1	R2	R3	R4	R5	R6	R7
43	51K	56K	56K	47K	75K	51K	150K
44	91K		91K	75K	75K	18K	36K
45	51K	68K	68K	47K	75K	51K	180K
46	130K		91K	100K	100K	18K	47K
47	51K	68K	68K	56K	150K	51K	180K
48	130K		91K	100K	100K	18K	47K
49	22K	22K					
50							
51	130K	130K	130K				
52		150K	150K	160K			

NETWORK RESISTOR VALUES

N	R 1	R2	R3	R4	R5	R6	R7
53	100K	150K	150K				
54		390K	390K	240K			


P98-3 S98-3 P42-3 BRITBL
P98-4 S98-4 P52-3 BRITBM
P98-5 S98-5 P62-3 BRITBH
N29 SAW LEVEL LOW 1
NETWORK 949-042703-002
N30 SAW LEVEL LOW 2
NETWORK 949-042824-001
N31 SAW LEVEL HIGH 1
NETWORK 949-042705-002
N32 SAW LEVEL HIGH 2
NETWORK 949-042704-001
N33 DRIVE LEVEL LIMIT 1
NETWORK 949-042706-001
N34 DRIVE LEVEL LIMIT 2
NETWORK 949-042707-002
N35 DECAY LOW 1
NETWORK 949-042708-002
N36 DECAY LOW 2
NETWORK 949-042709-002
N37 DECAY HIGH 1
NETWORK 949-042708-002
N38 DECAY HIGH 2
NETWORK 949-042709-002
N39 DYNAMICS 1
NETWORK 949-042710-002
N40 DYNAMICS 2
NETWORK 949-042711-002
N41 SUSTAIN 1
NETWORK 949-042712-003
N42 SUSTAIN 2
NETWORK 949-042713-002
N43 PW LOW 1
NETWORK 949-042714-002
N44 PW LOW 2
NETWORK 949-042715-001
N45 PW MED 1
NETWORK 949-042825-001
N46 PW MED 2
NETWORK 949-042717-001
N47 PW HIGH 1
NETWORK 949-042716-002
N48 PW HIGH 2
NETWORK 949-042717-001
N49 PRESET 1-7
NETWORK 949-042718-001
N50 PRESET 8-14
NETWORK 949-042719-002
N51 VAR LOUD ATTACK 1
NETWORK 949-042720-001
N52 VAR LOUD ATTACK 2
NETWORK 949-042721-001
N53 LOUD ATTACK 1
NETWORK 949-042722-002
N54 LOUD ATTACK 2
NETWORK 949-042723-002
REAR PANEL
SCALE
R110 2K LIN.
R77 100K
R78 100K
R79 100K
R76 68K
R80 47K
A11A
A11B
FRONT PANEL
ATTACK
10K R109B
DUAL LIN
KEYBOARD
BOT LOW
BOT 2OCT
TOP LOW
BOT HIGH
TOP 4OCT
TOP HIGH
BUSS
R81 9.31K MF
R82 9.31K MF
R83 7.15K MF
A12B
500pf
C15
R84 330K
R86 10K
R87 220
A12A
C10 47
R88 1K
IC11D
REAR PANEL
KBD RANGE
R111 100K LIN
KBD C.V. OUT
R112 2.5M AUD
AUD
GLIDE ON/OFF
C11 .01
R90 470
C12 47
A13
R89 100K
Q8 2N3904
R91 100K
IC11A
P910-1 S910-1
P78-1 ATTACK
IC11B
R92 47K
R93 100K
S95-5
IC11C
P102-3
P99-4 S99-4
TRIGGER CIRCUIT
C6 .0068
R64 68K
R65 10K
A10A
A10B
C8 .022
R66 10K
C7 .01
R68 100K
R71 4.7M
A9A
R69 10K
R70 10K
R72 100K
R73 4.7M
C9 500PF
R67 10K
Q7 2N3904
C13 .001
R94 1M
R95 1M
R96 15K
IC6D
ATTACK
4016
R97 2.2K
R98 300
VAR ATTACK
Q9 2N3906
CR5
R99 910
C14 2.7/35V TANT.
IC12 4007
IC13 4007
Q10
Q11
Q12
Q13
Q14
Q15
Q16
R100 100K
R101 100K
R102 3.3K
SUSTAIN
R103 1K
R104 51K DECAY
P910-10 S910-10
P81-7
R109A 10K DUAL LIN.
ATTACK FRONT PANEL
KEYBOARD
R74 4.7K
Q5 2N3904
Q6 2N3906
R75 4.7K
REAR PANEL
SUSTAIN
J2
C16 2.7
FOOT SUSTAIN CIRCUIT
P41-3 FTSUBL S98-6 P98-6
P51-3 FTSUBM S98-7 P98-7
P61-3 FTSUBH S98-8 P98-8
SINGLE MULTI TRIG
FOOTJACK
J3
SW1
SWITCH REAR PANEL
STRIG IN/OUT
2 CONDUCTOR SHIELDED CABLE
TRGB

R VALUES

	R5	R6	R7
K	75K	51K	150K
K	75K	18K	36K
K	75K	51K	180K
K	100K	18K	47K
K	150K	51K	180K
K	100K	18K	47K
K			

R VALUES

	R5	R6	R7
K			

FUTURE NETWORK RESISTOR VALUES

N	R4	R5	R6	R7	R8	R9	R10	R11	R12	R19
1										
2	R13	R14	R15	R16	R17	R18				

N	R1	R2	R3	R4	R5	R6	R7
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

N	R1	R2	R3	R4	R5	R6	R7
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							

N	R1	R2	R3	R4	R5	R6	R7
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							

N	R1	R2	R3	R4	R5	R6	R7
33							
34							
35							
36							
37							
38							
39							
40							
41							
42							

N	R1	R2	R3	R4	R5	R6	R7
43							
44							
45							
46							
47							
48							
49							
50							
51							
52							

N	R1	R2	R3	R4	R5	R6	R7
53							
54							

COMPONENT BASING (TOP VIEW)

1
8
4
5
1
14
7
8
1
16
8
9
E B C

MC1458CP-1
LF356N
LM358N
TL082

CD4016AE
SN7426

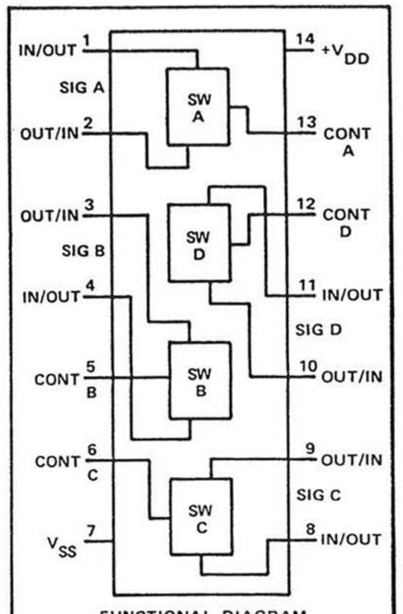
CD4007AE
CD4051AE

2N3904
2N3906

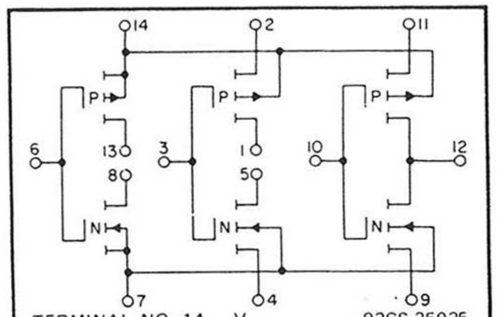
NOTES:

1. UNLESS OTHERWISE SPECIFIED– ALL RESISTORS ARE IN OHMS, 1/4W, ± 5%. ALL CAPACITORS ARE IN MFD (uf), ALL DIODES ARE 1N4148.

* IC13 TO BE SELECTED


IN/OUT 1
SIG A
OUT/IN 2
OUT/IN 3
SIG B
IN/OUT 4
CONT B 5
CONT C 6
VSS 7
8 IN/OUT
SIG C
9 OUT/IN
10 OUT/IN
SIG D
11 IN/OUT
12 CONT D
13 CONT A
14 +VDD
SW A
SW D
SW B
SW C

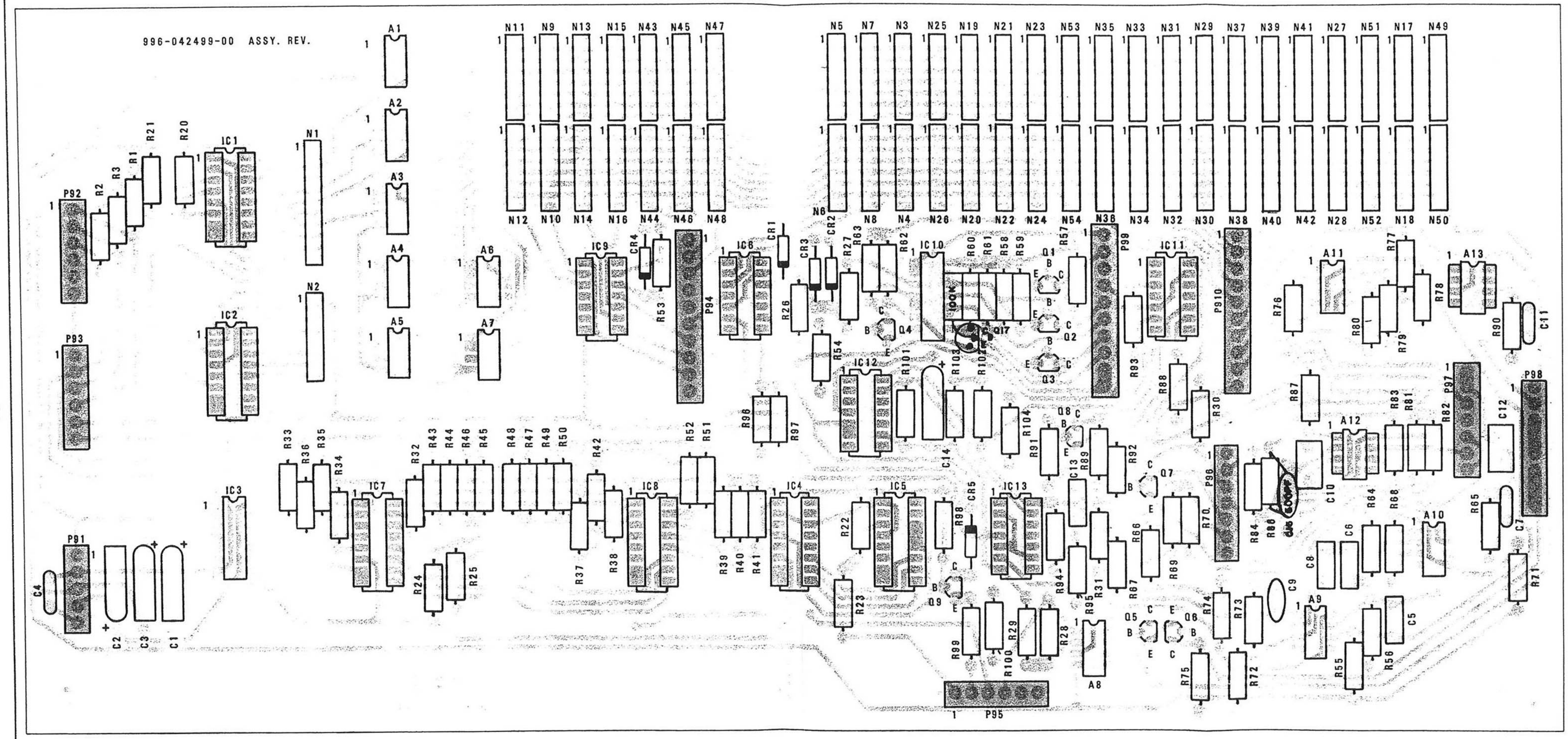
FUNCTIONAL DIAGRAM
4016


14
2
11
6
13
8
3
1
5
10
12
7
4
9
P
N
92CS-25035

TERMINAL NO. 14 – V_{DD}
TERMINAL NO. 7 – V_{SS}
FUNCTIONAL DIAGRAM CD4007A

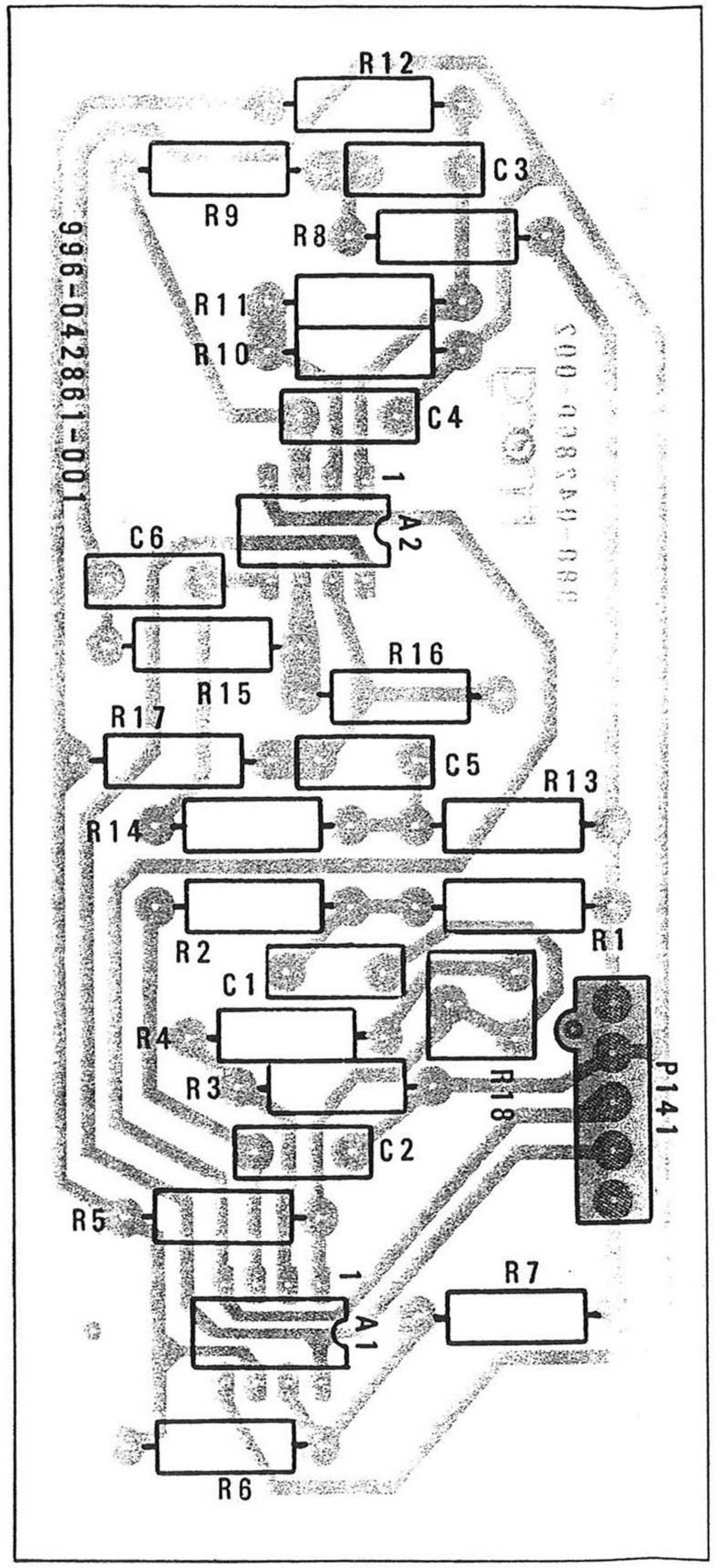
REV	DESCRIPTION	EO
A	RELEASED FOR PRODUCTION	0551
B	NEXT ASSEMBLY WAS 981-042497	0790
C	REVISED RESISTOR NETWORK VALUES	0807
D	N17 WAS -001, N41 WAS -002	0813
E	ADDED Q17, R113; N29. 949-042694-002 WAS -001	0842
F	ADDED C15, 500PF	0877
G	RENUMBERED R109, R106, R108	0910
H	ADDED 2.7 CAPACITOR TO J2	0934
J	IC13 IS SELECTED	1027
K	CHANGED P81-9 TO P81-7	1101
L	N39 RENUMBERED R106, ADDED 10K VALUE	1107

996-042499
TR BOARD 9


996-042499-00 ASSY. REV.
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
N1
N2
N11 N9 N13 N15 N43 N45 N47
N12 N10 N14 N16 N44 N46 N48
N5 N7 N3 N25 N19 N21 N23 N53 N35 N33 N31 N29 N37 N39 N41 N27 N51 N17 N49
N6 N8 N4 N26 N20 N22 N24 N54 N36 N34 N32 N30 N38 N40 N42 N28 N52 N18 N50
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC8
IC9
IC10
IC11
IC12
IC13
P91
P92
P93
P94
P95
P96
P97
P98
P99
P910
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q17
CR1
CR2
CR3
CR4
CR5
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
C12
C13
C14
R1 R2 R3 R20 R21
R22 R23 R24 R25 R26 R27 R28 R29 R30 R31 R32
R33 R34 R35 R36 R37 R38 R39 R40 R41 R42
R43 R44 R45 R46 R47 R48 R49 R50 R51 R52 R53 R54 R55 R56 R57 R58 R59 R60 R61 R62 R63
R64 R65 R66 R67 R68 R69 R70 R71 R72 R73 R74 R75 R76 R77 R78 R79 R80 R81 R82 R83 R84 R86 R87 R88 R89 R90 R91 R92 R93 R94 R95 R96 R97 R98 R99 R100 R101 R102 R103 R104
E B C
100K

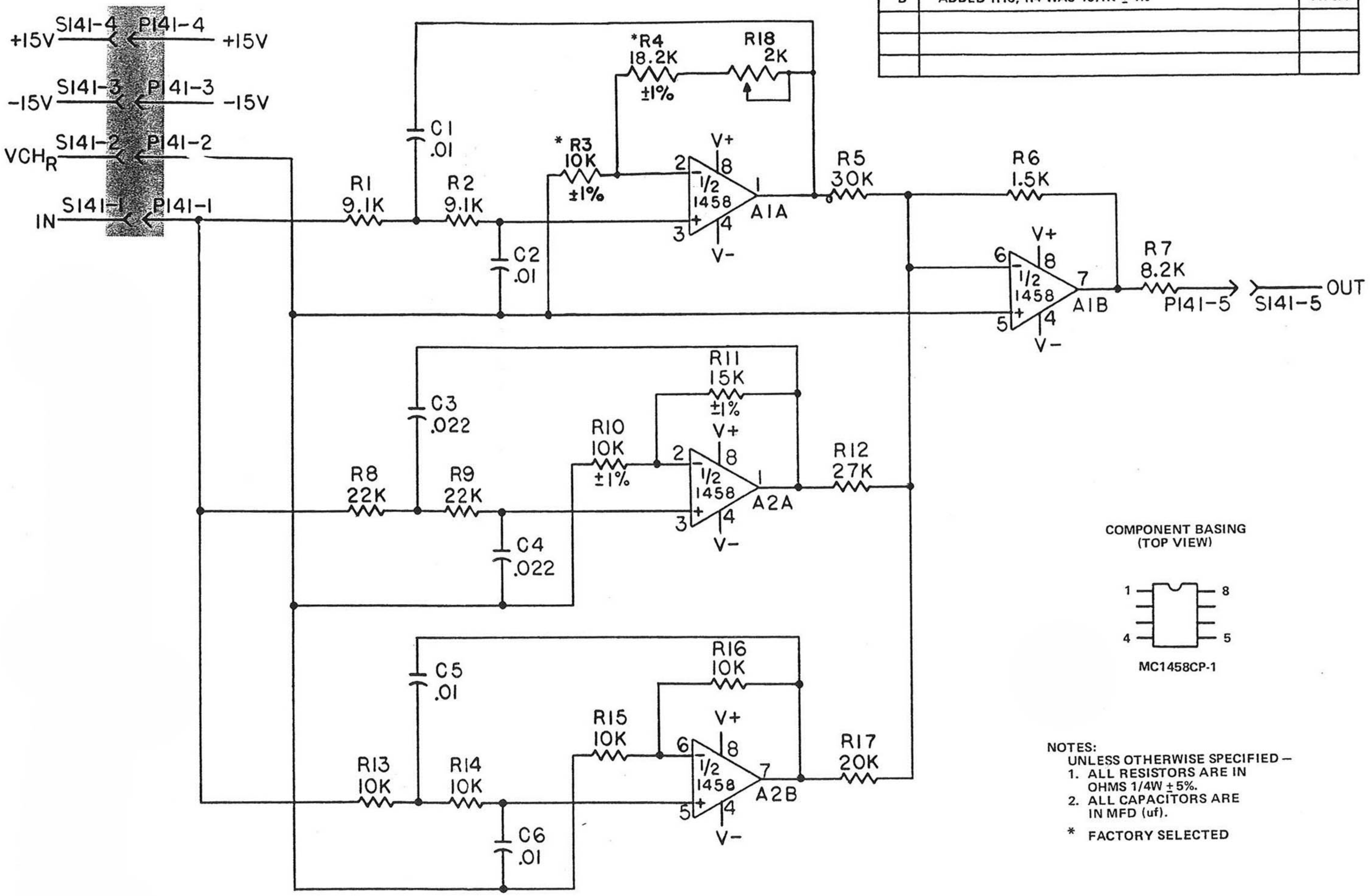
996-042499
TR BOARD 9

PROGRAM CONTROL PRINTED CIRCUIT TR BOARD 9 ASSEMBLY


R12
C3
R9
R8
R11
R10
C4
996-042861-001
1
A2
C6
R16
R15
R17
C5
R13
R14
R2
R1
C1
R4
R18
R3
P141
C2
R5
R7
1
A1
R6

NOTE:
REFER TO THE REPLACEMENT PARTS LIST IN VOLUME 1, SECTION 5 FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.

REV	DESCRIPTION	EO
A	RELEASED FOR PRODUCTION	0835
B	ADDED R18, R4 WAS 19.1K ± 1%	1173A

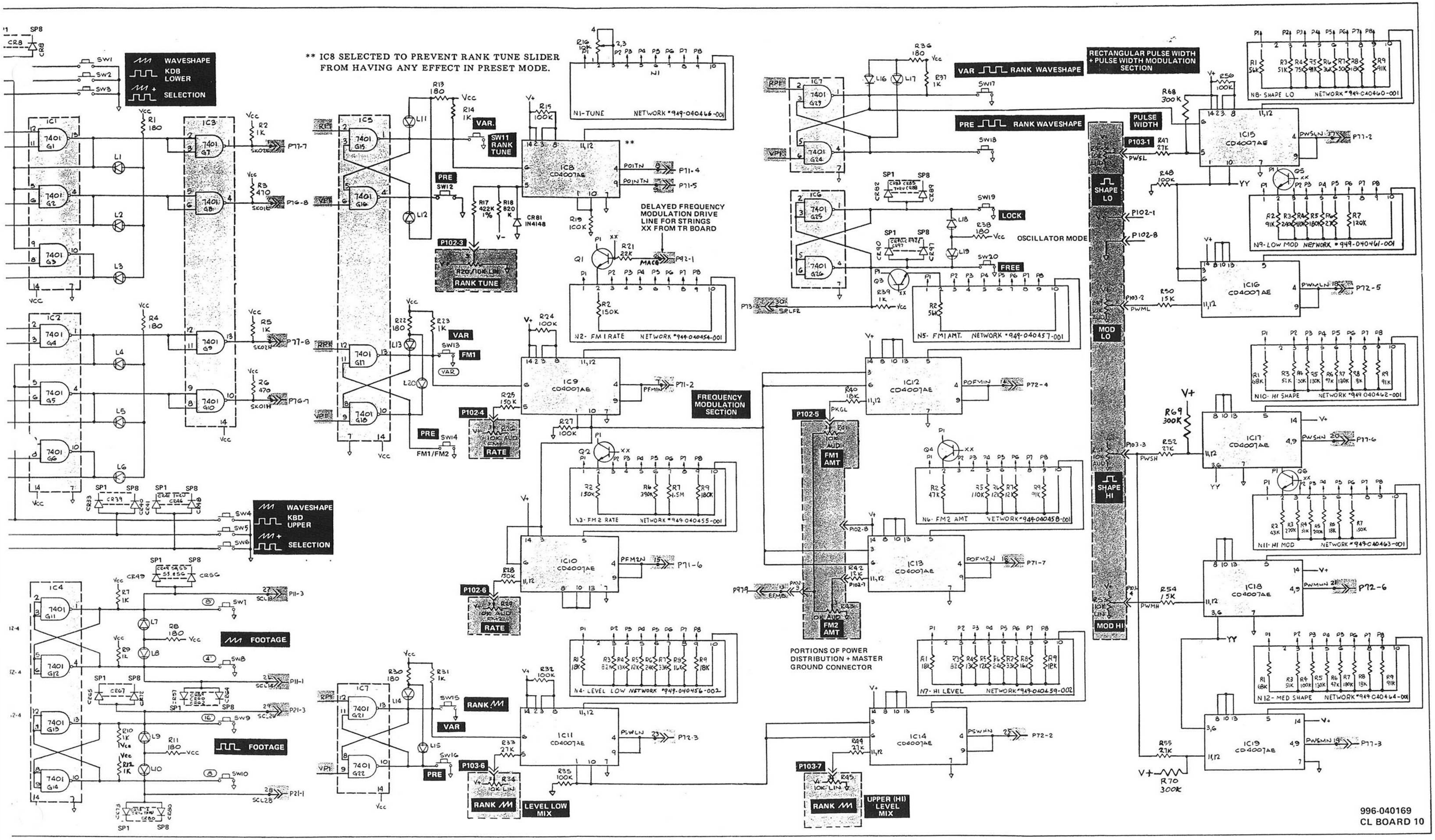

+15V
S141-4
P141-4
+15V
-15V
S141-3
P141-3
-15V
VCH$_R$
S141-2
P141-2
IN
S141-1
P141-1
C1
.01
R1
9.1K
R2
9.1K
C2
.01
*R3
10K
±1%
*R4
18.2K
±1%
R18
2K
V+
2
8
1/2
1458
1
A1A
3
4
V-
R5
30K
R6
1.5K
V+
6
8
1/2
1458
7
A1B
5
4
V-
R7
8.2K
P141-5
S141-5
OUT
C3
.022
R8
22K
R9
22K
C4
.022
R10
10K
±1%
R11
15K
±1%
V+
2
8
1/2
1458
1
A2A
3
4
V-
R12
27K
C5
.01
R13
10K
R14
10K
C6
.01
R15
10K
R16
10K
V+
6
8
1/2
1458
7
A2B
5
4
V-
R17
20K
COMPONENT BASING
(TOP VIEW)
1
8
4
5
MC1458CP-1

NOTES:
UNLESS OTHERWISE SPECIFIED –
1. ALL RESISTORS ARE IN OHMS 1/4W ± 5%.
2. ALL CAPACITORS ARE IN MFD (uf).
* FACTORY SELECTED

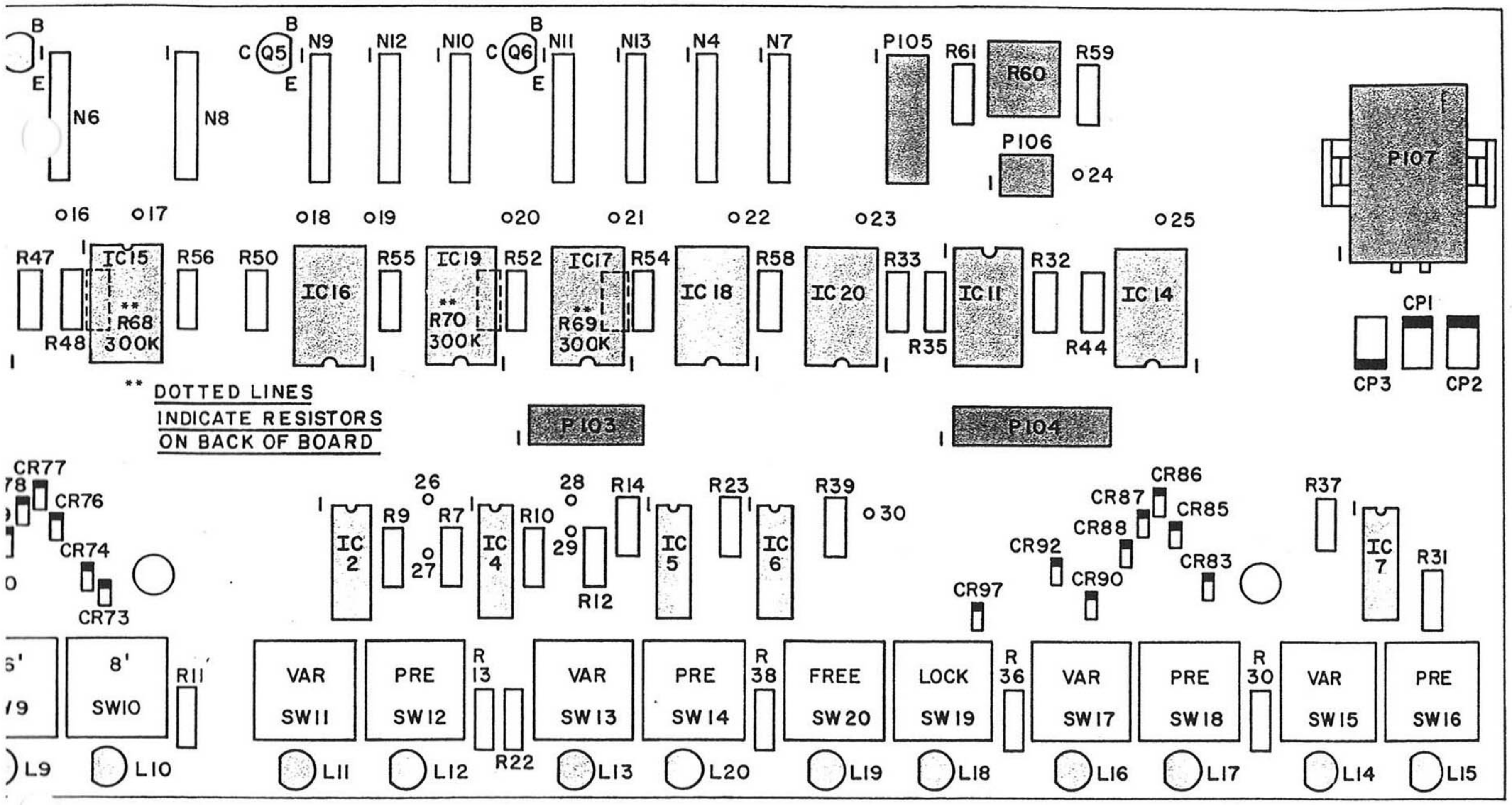
996-042861
VOX BOARD 14

VOX HUMANA SCHEMATIC DIAGRAM VOX BOARD 14

1	2	3	4	5	6	7	14
8	9	10	11	12	13	14	


** IC8 SELECTED TO PREVENT RANK TUNE SLIDER FROM HAVING ANY EFFECT IN PRESET MODE.
WAVESHAPE KDB LOWER SELECTION
WAVESHAPE KDB UPPER SELECTION
DELAYED FREQUENCY MODULATION DRIVE LINE FOR STRINGS XX FROM TR BOARD
FREQUENCY MODULATION SECTION
RECTANGULAR PULSE WIDTH + PULSE WIDTH MODULATION SECTION
VAR RANK WAVESHAPE
PRE RANK WAVESHAPE
PULSE WIDTH
SHAPE LO
MOD LO
SHAPE HI
MOD HI
OSCILLATOR MODE
LOCK
FREE
SW11 RANK TUNE
VAR.
PRE
RANK TUNE
R20 10K LIN
VAR
FM1
FM1/FM2
RATE
FM1 AMT
FM2 AMT
FOOTAGE
RANK
LEVEL LOW MIX
UPPER (HI) LEVEL MIX
PORTIONS OF POWER DISTRIBUTION + MASTER GROUND CONNECTOR
N1-TUNE NETWORK #949-040466-001
N2- FM1 RATE NETWORK #949-040454-001
N3- FM2 RATE NETWORK #949-040455-001
N4- LEVEL LOW NETWORK #949-040456-002
N5- FM1 AMT. NETWORK #949-040457-001
N6- FM2 AMT NETWORK #949-040458-001
N7- HI LEVEL NETWORK #949-040459-002
N8- SHAPE LO NETWORK #949-040460-001
N9- LOW MOD NETWORK #949-040461-001
N10- HI SHAPE NETWORK #949-040462-001
N11- HI MOD NETWORK #949-040463-001
N12- MED SHAPE NETWORK #949-040464-001
IC1 IC2 IC3 IC4 IC5 IC6 IC7 7401
IC8 IC9 IC10 IC11 IC12 IC13 IC14 IC15 IC16 IC17 IC18 IC19 CD4007AE
996-040169
CL BOARD 10

LEFT HAND CONTROL PANEL SCHEMATIC DIAGRAM CL BOARD 10 (POLYMOOG)

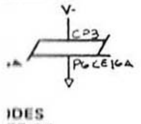


N6
N8
Q5
N9
N12
N10
Q6
N11
N13
N4
N7
P105
R61
R60
R59
P106
24
P107
16
17
18
19
20
21
22
23
25
R47
IC15
R56
R50
R55
IC19
R52
IC17
R54
R58
R33
R32
R48
R68 300K
IC16
R70 300K
R69 300K
IC 18
IC 20
IC11
IC 14
R35
R44
CP1
CP3
CP2
** DOTTED LINES INDICATE RESISTORS ON BACK OF BOARD
P103
P104
CR77
CR76
CR74
CR73
26
28
R14
R23
R39
30
R9
R7
R10
IC 2
27
IC 4
29
R12
IC 5
IC 6
CR87
CR86
CR85
CR88
CR92
CR83
CR90
CR97
R37
IC 7
R31
8' SW10
R11
VAR SW11
PRE SW12
R 13
R22
VAR SW13
PRE SW14
R 38
FREE SW20
LOCK SW19
R 36
VAR SW17
PRE SW18
R 30
VAR SW15
PRE SW16
L9
L10
L11
L12
L13
L20
L19
L18
L16
L17
L14
L15

92
N OHMS 1/4W ± 5%

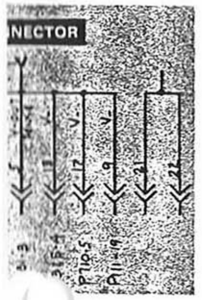
DIODES USED

TORS
ODES

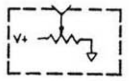


V-
CP3
P6 CE16A

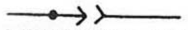
IDES
TE OR
IS
DEVICES



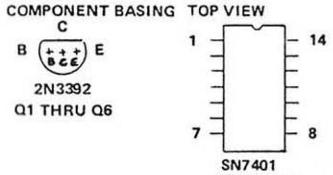
NECTOR
V-
P710-5
P111-19

5. 

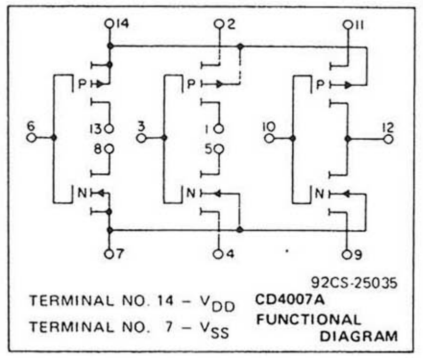
DENOTES CONTROL POT LEFT FRONT PANEL.

6. 
DENOTES PCB WIRE CONNECTION DESIGNATOR.

* MOUNTS UPSIDE DOWN ON FRONT PANEL



COMPONENT BASING
TOP VIEW
C
B
E
2N3392
Q1 THRU Q6
1
14
7
8
SN7401
CD4007AE



14
2
11
6
3
10
12
P
N
13
8
1
5
7
4
9
92CS-25035
TERMINAL NO. 14 – V_DD
TERMINAL NO. 7 – V_SS
CD4007A FUNCTIONAL DIAGRAM

4007

REV	DESCRIPTION	EO
A	REVISED AND RELEASED FOR PRODUCTION	0192
B	REVISED PER EO 0233	0233
C	CHANGED R9 IN N4 AND N7 FROM 12K TO 18K	0448
D	CHANGED CR81 FROM 1N14A TO 1N4148	0470
F	ADDED R68 300K, R69 300K AND R70 300K; R17, 430K WAS 470K; R18, 820K WAS 1M; R62, 5K WAS 10K; UPDATED FOR SERVICE MANUAL	0658
G	R17 WAS 430K 1/4W ± 5%	0781
H	NEXT ASSEMBLY WAS 981-040167	0790
J	CONNECTOR PIN NO. REVISED PER EO	1101
K	R16 REMOVED	1148

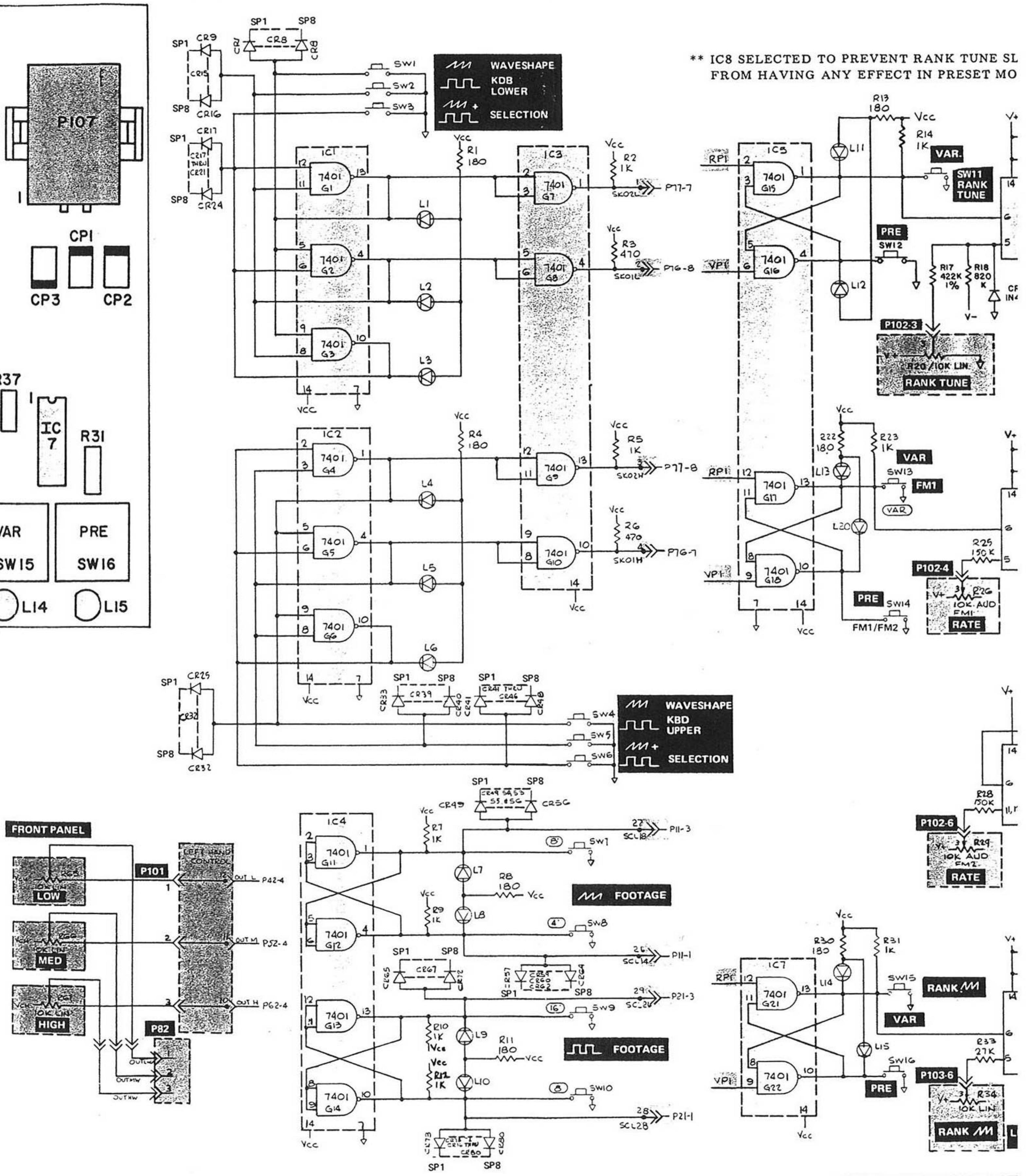
FUTURE RESISTOR VALUES

N	R1	R2	R3	R4	R5	R6	R7	R8	R9
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									

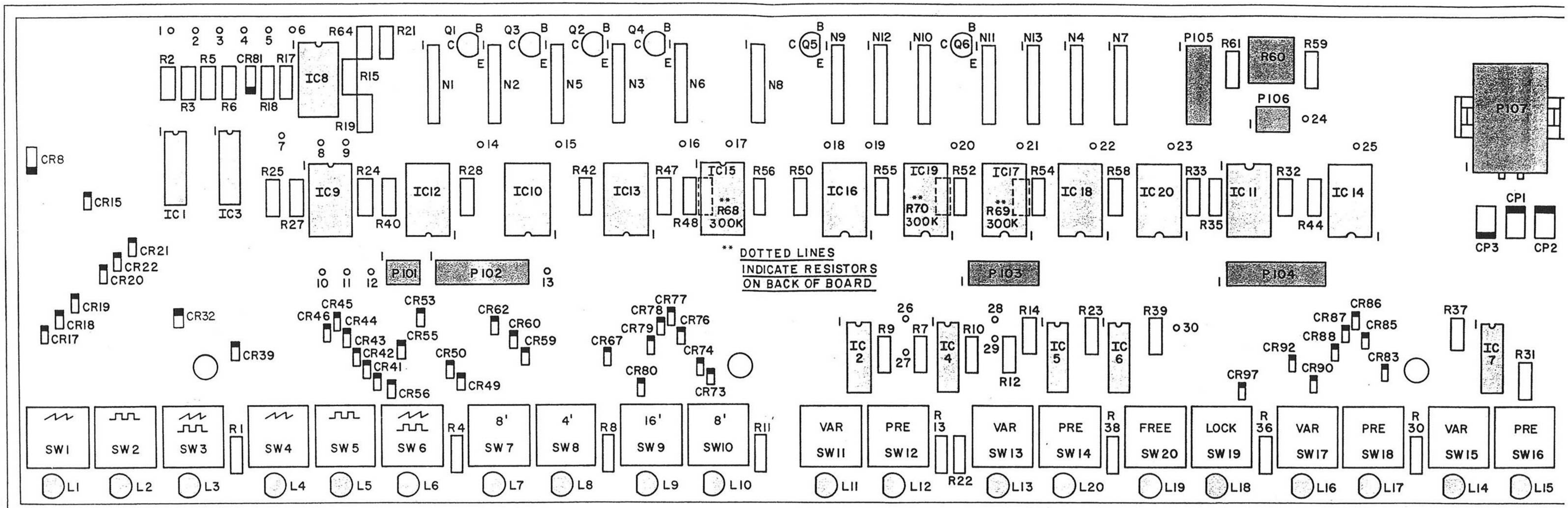
NETWORK RESISTOR VALUES

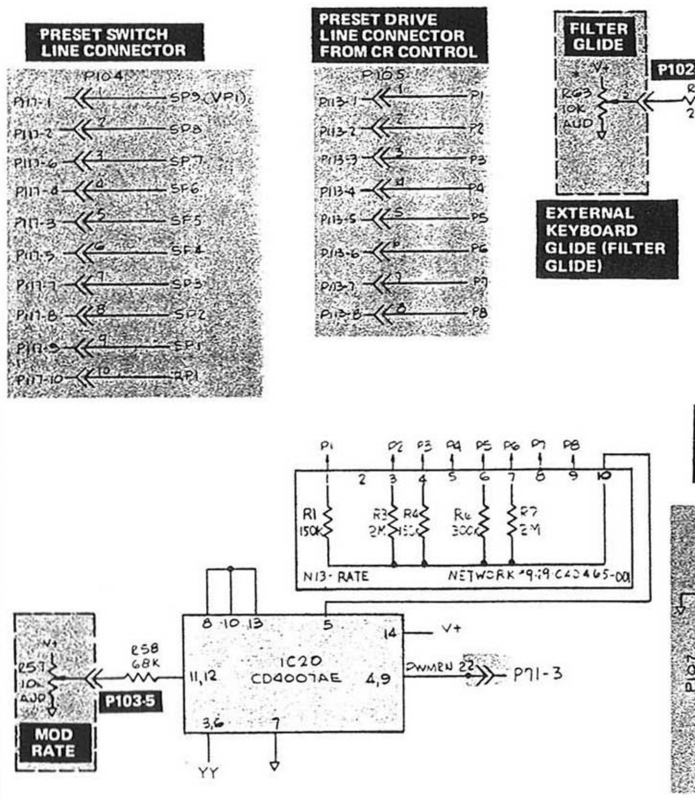
N	R1	R2	R3	R4	R5	R6	R7	R8	R9
1									
2		150K							
3		150K				390K	1.5M		180K
4	18K		82K	13K	12K	24K	33K	16K	18K
5		56K							
6		47K			110K	12K	12K		91K
7	18K		82K	13K	12K	24K	33K	16K	18K
8	56K		51K	75K	91K	36K	150K	18K	91K
9		91K	240K	110K	180K	27K	120K		
10	68K		51K	100K	130K	47K	180K	18K	91K
11		43K	270K	51K	200K	18K	150K		
12	68K		51K	100K	130K	47K	180K	18K	91K
13	150K		2M	150K		300K	2M		

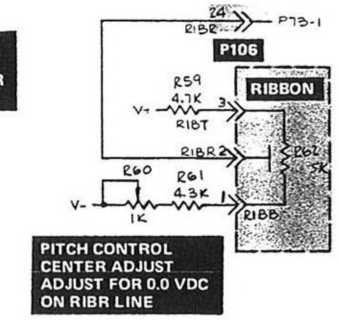
** IC8 SELECTED TO PREVENT RANK TUNE SL
FROM HAVING ANY EFFECT IN PRESET MO



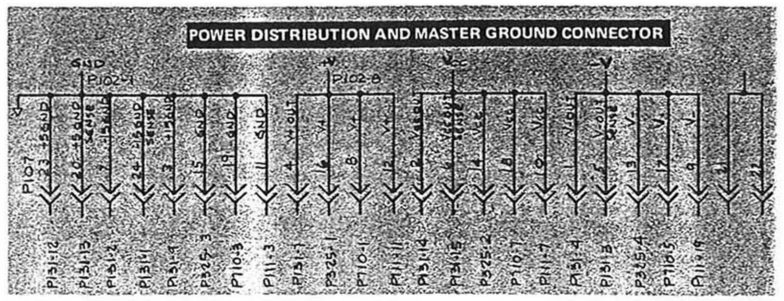
SP1
SP8
CR9
CR8
CR15
CR16
CR17
CR21
CR24
SW1
SW2
SW3
WAVESHAPE
KDB LOWER
SELECTION
IC1
7401 G1
7401 G2
7401 G3
L1
L2
L3
R1 180
IC3
7401 G7
7401 G8
R2 1K
R3 470
SK02L
SK01L
P77-7
P16-8
R13 180
Vcc
R14 1K
IC5
RP1
VP1
7401 G15
7401 G16
L11
L12
VAR.
SW11 RANK TUNE
PRE
SW12
R17 422K 1%
R18 820 K
P102-3
R20 10K LIN.
RANK TUNE
IC2
7401 G4
7401 G5
7401 G6
L4
L5
L6
R4 180
7401 G9
7401 G10
R5 1K
R6 470
SK02H
SK01H
P77-8
P16-7
R22 180
R23 1K
L13
L20
7401 G17
7401 G18
SW13
VAR
FM1
R25 150K
P102-4
SW14
R26 10K AUD FM1
RATE
FM1/FM2
CR25
CR32
CR33
CR39
CR41
CR45
CR46
CR48
SW4
SW5
SW6
WAVESHAPE
KBD UPPER
SELECTION
R28 150K
P102-6
R29 10K AUD FM2
RATE
FRONT PANEL
10K LIN LOW
10K LIN MED
10K LIN HIGH
P101
LEFT HAND CONTROL
OUT L
OUT M
OUT H
P42-4
P52-4
P62-4
P82
IC4
7401 G11
7401 G12
7401 G13
7401 G14
R7 1K
R8 180
R9 1K
R10 1K
R11 180
R12 1K
L7
L8
L9
L10
CR49
CR56
CR65
CR67
CR73
CR80
SW7
SW8
SW9
SW10
FOOTAGE
SCL18
SCL14
SCL26
SCL28
P11-3
P11-1
P21-3
P21-1
R30 180
R31 1K
IC7
7401 G21
7401 G22
L14
L15
SW15
RANK
VAR
SW16
PRE
R33 27K
P103-6
R34 10K LIN
RANK
Vcc
V+
V-


R64
R21
Q1
Q3
Q2
Q4
Q5
Q6
R2
R5
CR81
R17
R3
R6
R18
IC8
R15
R19
N1
N2
N5
N3
N6
N8
N9
N12
N10
N11
N13
N4
N7
P105
R61
R60
R59
P106
P107
CR8
CR15
IC1
IC3
R25
R27
IC9
R24
R40
IC12
R28
IC10
R42
IC13
R47
R48
IC15
R68 300K
R56
R50
IC16
R55
IC19
R70 300K
R52
IC17
R69 300K
R54
IC18
R58
IC20
R33
R35
IC11
R32
R44
IC14
CP1
CP2
CP3
CR21
CR22
CR20
P101
P102
** DOTTED LINES INDICATE RESISTORS ON BACK OF BOARD
P103
P104
CR19
CR18
CR17
CR32
CR39
CR45
CR46
CR44
CR43
CR42
CR41
CR56
CR53
CR55
CR62
CR60
CR59
CR50
CR49
CR77
CR78
CR76
CR79
CR67
CR74
CR80
CR73
IC2
R9
R7
IC4
R10
R14
R12
IC5
R23
IC6
R39
CR86
CR87
CR85
CR88
CR92
CR90
CR83
CR97
R37
IC7
R31
SW1
SW2
SW3
R1
SW4
SW5
SW6
R4
8' SW7
4' SW8
R8
16' SW9
8' SW10
R11
VAR SW11
PRE SW12
R13
VAR SW13
PRE SW14
R38
FREE SW20
LOCK SW19
R36
VAR SW17
PRE SW18
R30
VAR SW15
PRE SW16
R22
L1
L2
L3
L4
L5
L6
L7
L8
L9
L10
L11
L12
L13
L20
L19
L18
L16
L17
L14
L15


PRESET SWITCH LINE CONNECTOR
P104
PRESET DRIVE LINE CONNECTOR FROM CR CONTROL
P105
FILTER GLIDE
P102-2
R63 10K
R64 27K
P95-1
EXTERNAL KEYBOARD GLIDE (FILTER GLIDE)
N13 - RATE
R1 150K
R3
R4
R6 300K
R7 2M
IC20 CD4007AE
R58 68K
P103-5
MOD RATE
P71-3
V+

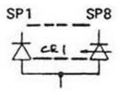

P73-1
P106
RIBBON
R59 4.7K
R60
R61 4.3K
R62 5K
1K
V+
V-

PITCH CONTROL CENTER ADJUST ADJUST FOR 0.0 VDC ON RIBR LINE

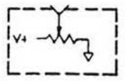

POWER DISTRIBUTION AND MASTER GROUND CONNECTOR

NOTES:

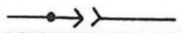
UNLESS OTHERWISE SPECIFIED

1. ALL TRANSISTORS ARE 2N3392
2. ALL RESISTOR VALUES ARE IN OHMS 1/4W ± 5%
3. ALL DIODES ARE 1N4148
4. 

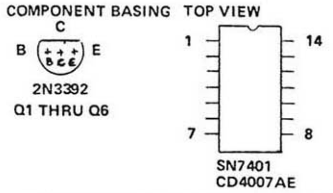
DENOTES DIODES USED

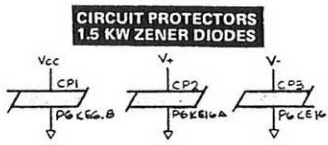
5. 

DENOTES CONTROL POT LEFT FRONT PANEL.

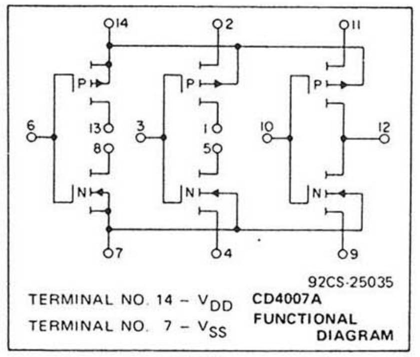
6. 
DENOTES PCB WIRE CONNECTION DESIGNATOR.

* MOUNTS UPSIDE DOWN ON FRONT PANEL


COMPONENT BASING
TOP VIEW
C
B
E
2N3392
Q1 THRU Q6
1
14
7
8
SN7401
CD4007AE


CIRCUIT PROTECTORS 1.5 KW ZENER DIODES
Vcc
CP1
V+
CP2
V-
CP3

REPLACE THESE DIODES BUT DO NOT OPERATE OR TROUBLESHOOT THIS BOARD WITH THESE DEVICES REMOVED


14
2
11
6
13
8
3
1
5
10
12
7
4
9
P
N
TERMINAL NO. 14 - V_DD
TERMINAL NO. 7 - V_SS
92CS-25035
CD4007A FUNCTIONAL DIAGRAM

4007

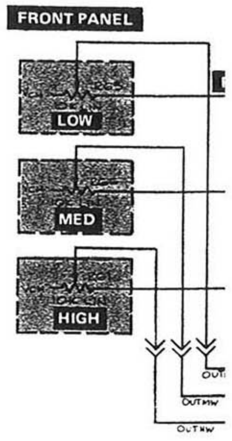
REV	DESCRIPTION	EO
A	REVISED AND RELEASED FOR PRODUCTION	0192
B	REVISED PER EO 0233	0233
C	CHANGED R9 IN N4 AND N7 FROM 12K TO 18K	0448
D	CHANGED CR81 FROM 1N14A TO 1N4148	0470
F	ADDED R68 300K, R69 300K AND R70 300K; R17, 430K WAS 470K; R18, 820K WAS 1M; R62, 5K WAS 10K; UPDATED FOR SERVICE MANUAL	0658
G	R17 WAS 430K 1/4W ± 5%	0781
H	NEXT ASSEMBLY WAS 981-040167	0790
J	CONNECTOR PIN NO. REVISED PER EO	1101
K	R16 REMOVED	1148

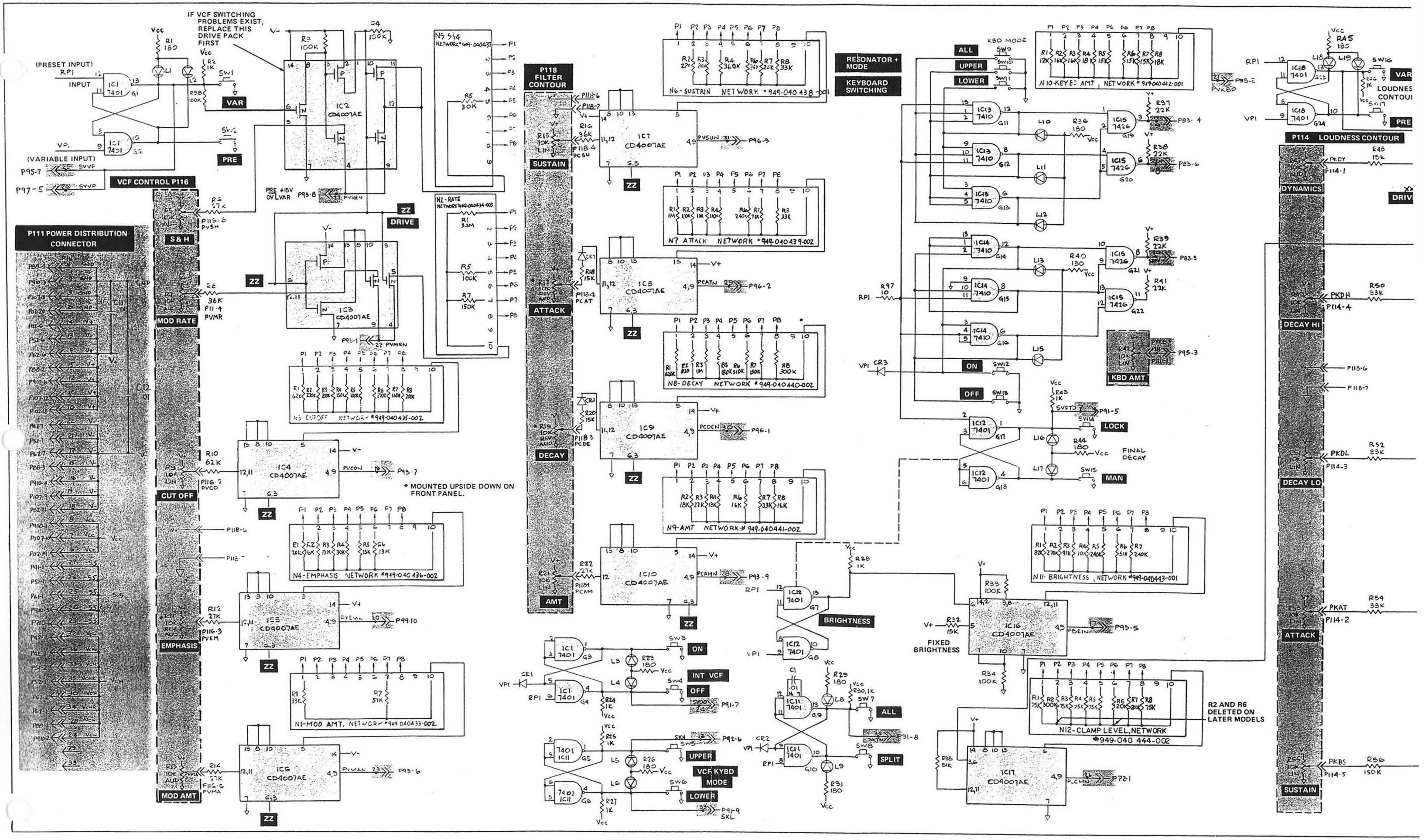
FUTURE RESISTOR VALUES

N	R1	R2	R3	R4	R5	R6	R7	R8	R9
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									

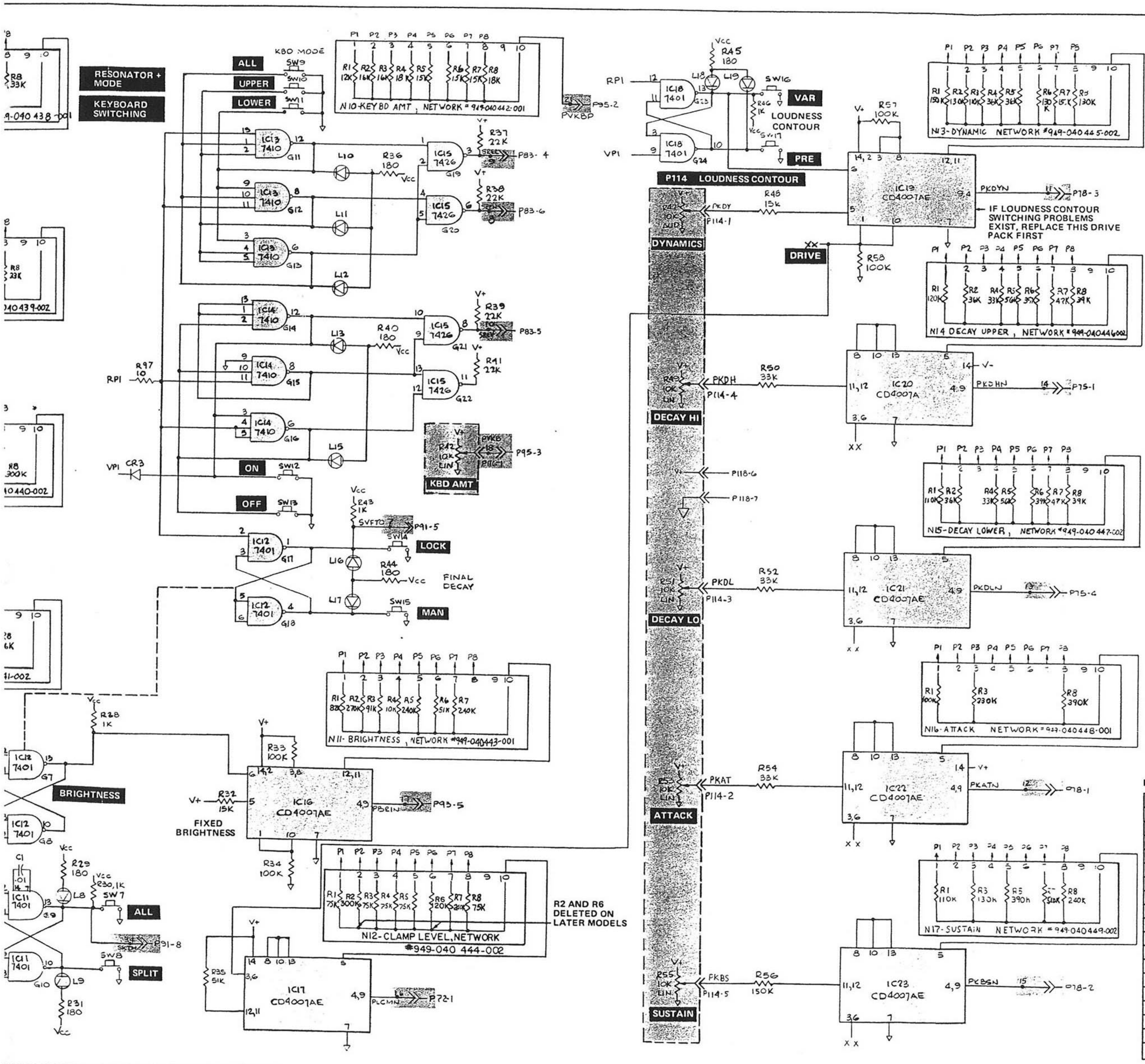
NETWORK RESISTOR VALUES

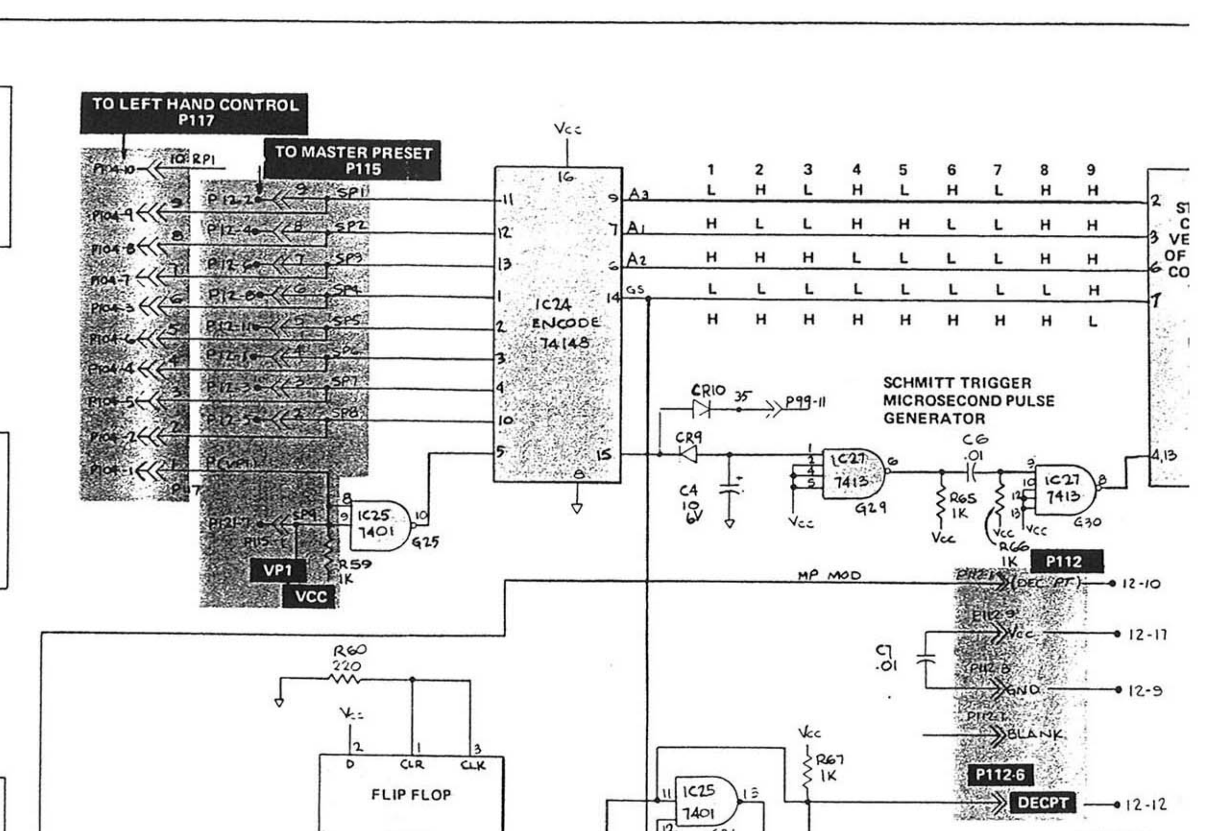
N	R1	R2	R3	R4	R5	R6	R7	R8	R9
1									
2		150K							
3		150K				390K	1.5M		180K
4	18K		82K	13K	12K	24K	33K	16K	18K
5		56K							
6		47K			110K	12K	12K		91K
7	18K		82K	13K	12K	24K	33K	16K	18K
8	56K		51K	75K	91K	36K	150K	18K	91K
9		91K	240K	110K	180K	27K	120K		
10	68K		51K	100K	130K	47K	180K	18K	91K
11		43K	270K	51K	200K	18K	150K		
12	68K		51K	100K	130K	47K	180K	18K	91K
13	150K		2M	150K		300K	2M		

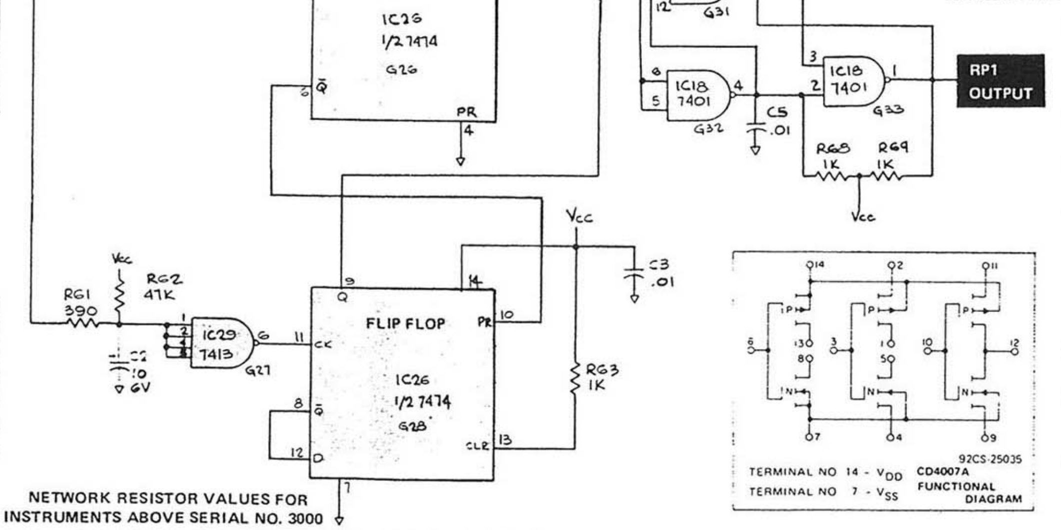

FRONT PANEL
LOW
MED
HIGH


IF VCF SWITCHING PROBLEMS EXIST, REPLACE THIS DRIVE PACK FIRST
(PRESET INPUT) RP1
INPUT
(VARIABLE INPUT)
VAR
PRE
VCF CONTROL P116
P111 POWER DISTRIBUTION CONNECTOR
S & H
MOD RATE
CUT OFF
EMPHASIS
MOD AMT
IC1 7401
IC2 CD4007AE
IC3 CD4007AE
IC4 CD4007AE
IC5 CD4007AE
IC6 CD4007AE
DRIVE
ZZ
N5 S&H NETWORK
N2 - RATE
N3 CUTOFF NETWORK #949-040435-002
N4-EMPHASIS NETWORK #949-040436-002
N1-MOD AMT. NETWORK #949-040433-002
* MOUNTED UPSIDE DOWN ON FRONT PANEL.
P118 FILTER CONTOUR
SUSTAIN
ATTACK
DECAY
AMT
IC7 CD4007AE
IC8 CD4007AE
IC9 CD4007AE
IC10 CD4007AE
N6-SUSTAIN NETWORK #949-040438-001
N7 ATTACK NETWORK #949-040439-002
N8-DECAY NETWORK #949-040440-002
N9-AMT NETWORK #949-040441-002
ON
INT VCF
OFF
UPPER
VCF KYBD MODE
LOWER
BRIGHTNESS
ALL
SPLIT
RESONATOR + MODE
KEYBOARD SWITCHING
KBD MODE
ALL
UPPER
LOWER
N10-KEYED AMT NETWORK #949-040442-001
KBD AMT
ON
OFF
LOCK
FINAL DECAY
MAN
FIXED BRIGHTNESS
IC16 CD4007AE
IC17 CD4007AE
N11-BRIGHTNESS NETWORK #949-040443-001
N12-CLAMP LEVEL, NETWORK #949-040 444-002
R2 AND R6 DELETED ON LATER MODELS
P114 LOUDNESS CONTOUR
LOUDNESS CONTOUR
DYNAMICS
DECAY HI
DECAY LO
ATTACK
SUSTAIN
DRIV

RIGHT HAND CONTROL PANEL AND MASTER PRESET SCHEMATIC DIAGRAM CR BOARD 11


RESONATOR + MODE
KEYBOARD SWITCHING
KBD MODE
ALL
UPPER
LOWER
SW9
SW10
SW11
IC13 7410
IC14 7410
IC15 7426
N10-KEYBD AMT, NETWORK #949-040442-001
P95-2
PVKBP
RP1
VP1
IC18 7401
SW16
VAR
PRE
LOUDNESS CONTOUR
P114 LOUDNESS CONTOUR
DYNAMICS
DECAY HI
DECAY LO
ATTACK
SUSTAIN
KBD AMT
DRIVE
IC19 CD4007AE
IF LOUDNESS CONTOUR SWITCHING PROBLEMS EXIST, REPLACE THIS DRIVE PACK FIRST
N13-DYNAMIC NETWORK #949-040445-002
N14 DECAY UPPER, NETWORK #949-040446-002
IC20 CD4007A
N15-DECAY LOWER, NETWORK #949-040447-002
IC21 CD4007AE
N16-ATTACK NETWORK #949-040448-001
IC22 CD4007AE
N17-SUSTAIN NETWORK #949-040449-002
IC23 CD4007AE
ON
OFF
LOCK
MAN
FINAL DECAY
IC12 7401
BRIGHTNESS
FIXED BRIGHTNESS
IC16 CD4007AE
N11-BRIGHTNESS, NETWORK #949-040443-001
N12-CLAMP LEVEL, NETWORK #949-040 444-002
R2 AND R6 DELETED ON LATER MODELS
IC17 CD4007AE
IC11 7401
SPLIT


TO LEFT HAND CONTROL P117
TO MASTER PRESET P115
IC24 ENCODE 74148
1 2 3 4 5 6 7 8 9
A3 L H L H L H L H H
A1 H L L H H L L H H
A2 H H H L L L L H H
G5 L L L L L L L H H
H H H H H H H H L
IC25 7401
VP1
VCC
SCHMITT TRIGGER MICROSECOND PULSE GENERATOR
IC27 7413
P112
MP MOD
DEC PT
BLANK
P112-6
DECPT
12-10
12-17
12-9
12-12


FLIP FLOP
IC26 1/2 7474
G26
IC25 7401
IC18 7401
RP1 OUTPUT
IC29 7413
FLIP FLOP
IC26 1/2 7474
G28
92CS-25035
TERMINAL NO 14 - VDD
TERMINAL NO 7 - VSS
CD4007A FUNCTIONAL DIAGRAM

NETWORK RESISTOR VALUES FOR INSTRUMENTS ABOVE SERIAL NO. 3000

N	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10
N1							51K			
N2					100K		150K			
N3		270K	200K	150K	100K	270K	160K	200K		
N4		16K	13K	30K	12K	13K		27K		
N5					30K					
N6		27K	24K	360K		24K	24K	33K		
N7	1M	110K	9.1K	110K		240K	9.1K	33K		
N8	620K	820K	47K	80K		510K	150K	300K		
N9	12K	18K	16K	18K		16K	33K	10K		
N10	12K	16K	16K	18K	15K	15K	15K	18K		
N11	82K	270K	91K	10K	240K	51K	240K			
N12	75K	300K	75K	75K	75K	120K	240K	75K		
N13	150K	200K	100K	36K	36K	130K	150K	130K		
N14	33K	36K		33K	68K	39K	47K	39K		
N15	33K	36K		33K	68K	39K	47K	39K		
N16	100K		330K					390K		
N17	150K		220K		390K		510K	240K		

FUTURE RESISTOR VALUES

N	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10
N1										
N2										
N3										
N4										
N5										
N6										
N7										
N8										
N9										
N10										
N11										
N12										
N13										
N14										
N15										
N16										
N17										

NOTES:

UNLI

1. ALL OHM

2. ALL MFD

3. ALL

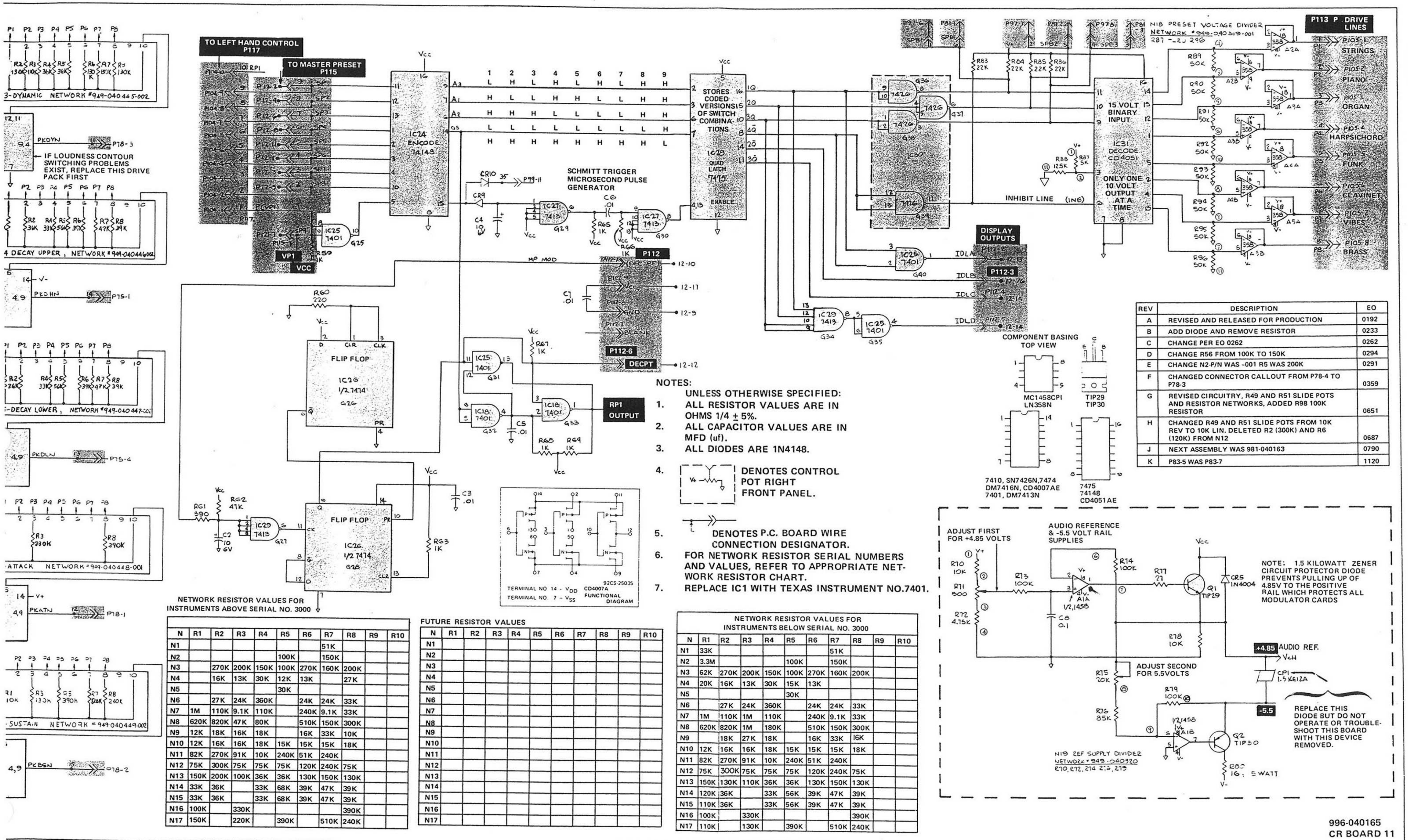
4.

5.

6. FOR AND WOR

7. REPL

N	R
N1	33
N2	3.
N3	62
N4	20
N5	
N6	
N7	1M
N8	62
N9	
N10	12
N11	82
N12	75
N13	15
N14	12
N15	11
N16	10
N17	11


P1 P2 P3 P4 P5 P6 P7 P8
R2 130K R3 110K R4 36K R5 36K R6 130K R7 150K R8 130K
3-DYNAMIC NETWORK #949-040445-002
12, 11
9,4
PKDYN
P78-3
IF LOUDNESS CONTOUR SWITCHING PROBLEMS EXIST, REPLACE THIS DRIVE PACK FIRST
R2 36K R4 33K R5 56K R6 39K R7 47K R8 39K
4 DECAY UPPER, NETWORK #949-040446-002
14 V-
4.9
PKDHN
P75-1
R2 36K R4 33K R5 56K R6 39K R7 47K R8 39K
DECAY LOWER, NETWORK #949-040447-002
PKDLN
P75-4
R3 230K R8 390K
ATTACK NETWORK #949-040448-001
14 V+
PKATN
P78-1
R1 10K R3 130K R5 390K R7 510K R8 240K
SUSTAIN NETWORK #949-040449-002
PKBSN
P78-2
TO LEFT HAND CONTROL P117
TO MASTER PRESET P115
RP1
P104-9 P104-8 P104-7 P104-5 P104-6 P104-4 P104-3 P104-2 P104-1
P12-2 P12-4 P12-6 P12-8 P12-11 P12-1 P12-3 P12-5
SP1 SP2 SP3 SP4 SP5 SP6 SP7 SP8 SP9
P(VP1)
P117
P121-7
P115-1
VP1
VCC
R59 1K
IC25 7401 G25
Vcc
IC24 ENCODE 74148
A3 A1 A2 GS
1 2 3 4 5 6 7 8 9
L H L H L H L H H
H L L H H L L H H
H H H L L L L H H
L L L L L L L L H
H H H H H H H H L
CR10
35
P99-11
CR9
C4 10 6V
SCHMITT TRIGGER MICROSECOND PULSE GENERATOR
IC27 7413 G29
C6 .01
R65 1K
R66 1K
IC27 7413 G30
STORES CODED VERSIONS OF SWITCH COMBINATIONS
IC28 QUAD LATCH 7475
ENABLE
1Q 2Q 3Q 4Q̄ 2Q̄ 3Q̄
MP MOD
P112
P112-1 (DEC PT) 12-10
P112-9 VCC 12-17
C7 .01
P112-8 GND 12-9
P112-7 BLANK
P112-6
DECPT 12-12
R60 220
FLIP FLOP
IC26 1/2 7474 G26
D CLR CLK PR
R67 1K
IC25 7401 G31
IC18 7401 G32
C5 .01
IC18 7401 G33
R68 1K R69 1K
RP1 OUTPUT
RG1 390
RG2 47K
C2 10 6V
IC29 7413 G27
FLIP FLOP
IC26 1/2 7474 G28
C3 .01
R63 1K
92CS-25035
CD4007A FUNCTIONAL DIAGRAM
TERMINAL NO 14 - V_{DD}
TERMINAL NO 7 - V_{SS}
IC29 7413 G34
IC25 7401 G35
IC25 7401 G40
DISPLAY OUTPUTS
IDLA P112-2 12-13
IDLB P112-3 12-16
IDLC P112-4 12-15
IDLD P112-5 12-14
7426 G36
7426 G37
7426 G38
IC30
7426 G39
INHIBIT LINE (INB)
P97-6 P81-1 SPB1
P97-7 P81-2 SPB2
P97-8 P81-3 SPB3
R83 22K R84 22K R85 22K R86 22K
R88 125K R87 5K
15 VOLT BINARY INPUT
IC31 DECODE CD4051
ONLY ONE 10 VOLT OUTPUT AT A TIME
N18 PRESET VOLTAGE DIVIDER NETWORK #949-040319-001
R89 50K R90 50K R91 50K R92 50K R93 50K R94 50K R95 50K R96 50K
358 A2A A2B A3A A3B A4A A4B A5A A5B
P113 P. DRIVE LINES
P105-1 STRINGS
P105-2 PIANO
P105-3 ORGAN
P105-4 HARPSICHORD
P105-5 FUNK
P105-6 CLAVINET
P105-7 VIBES
P105-8 BRASS
COMPONENT BASING TOP VIEW
MC1458CPI LN358N
TIP29 TIP30
7410, SN7426N, 7474 DM7416N, CD4007AE 7401, DM7413N
7475 74148 CD4051AE
ADJUST FIRST FOR +4.85 VOLTS
AUDIO REFERENCE & -5.5 VOLT RAIL SUPPLIES
R70 10K
R71 500
R72 4.75K
R73 100K
C8 0.1
A1A 1/2,1458
R14 100K
R77 27
Q1 TIP29
CR5 1N4004
NOTE: 1.5 KILOWATT ZENER CIRCUIT PROTECTOR DIODE PREVENTS PULLING UP OF 4.85V TO THE POSITIVE RAIL WHICH PROTECTS ALL MODULATOR CARDS
R78 10K
+4.85 AUDIO REF.
VcH
ADJUST SECOND FOR 5.5VOLTS
R75 20K
R76 85K
R79 100K
CP1 1.5KE12A
-5.5
REPLACE THIS DIODE BUT DO NOT OPERATE OR TROUBLESHOOT THIS BOARD WITH THIS DEVICE REMOVED.
1/2,1458 A1B
Q2 TIP30
R80 16, 5 WATT
N19 REF SUPPLY DIVIDER NETWORK #949-040320 R70, R72, R74, R76, R79

NOTES:

UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS 1/4 ± 5%.
2. ALL CAPACITOR VALUES ARE IN MFD (uf).
3. ALL DIODES ARE 1N4148.
4. DENOTES CONTROL POT RIGHT FRONT PANEL.
5. DENOTES P.C. BOARD WIRE CONNECTION DESIGNATOR.
6. FOR NETWORK RESISTOR SERIAL NUMBERS AND VALUES, REFER TO APPROPRIATE NETWORK RESISTOR CHART.
7. REPLACE IC1 WITH TEXAS INSTRUMENT NO.7401.

REV	DESCRIPTION	EO
A	REVISED AND RELEASED FOR PRODUCTION	0192
B	ADD DIODE AND REMOVE RESISTOR	0233
C	CHANGE PER EO 0262	0262
D	CHANGE R56 FROM 100K TO 150K	0294
E	CHANGE N2-P/N WAS -001 R5 WAS 200K	0291
F	CHANGED CONNECTOR CALLOUT FROM P78-4 TO P78-3	0359
G	REVISED CIRCUITRY, R49 AND R51 SLIDE POTS AND RESISTOR NETWORKS, ADDED R98 100K RESISTOR	0651
H	CHANGED R49 AND R51 SLIDE POTS FROM 10K REV TO 10K LIN. DELETED R2 (300K) AND R6 (120K) FROM N12	0687
J	NEXT ASSEMBLY WAS 981-040163	0790
K	P83-5 WAS P83-7	1120

NETWORK RESISTOR VALUES FOR INSTRUMENTS ABOVE SERIAL NO. 3000

N	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10
N1							51K			
N2					100K		150K			
N3		270K	200K	150K	100K	270K	160K	200K		
N4		16K	13K	30K	12K	13K		27K		
N5					30K					
N6		27K	24K	360K		24K	24K	33K		
N7	1M	110K	9.1K	110K		240K	9.1K	33K		
N8	620K	820K	47K	80K		510K	150K	300K		
N9	12K	18K	16K	18K		16K	33K	10K		
N10	12K	16K	16K	18K	15K	15K	15K	18K		
N11	82K	270K	91K	10K	240K	51K	240K			
N12	75K	300K	75K	75K	75K	120K	240K	75K		
N13	150K	200K	100K	36K	36K	130K	150K	130K		
N14	33K	36K		33K	68K	39K	47K	39K		
N15	33K	36K		33K	68K	39K	47K	39K		
N16	100K		330K					390K		
N17	150K		220K		390K		510K	240K		

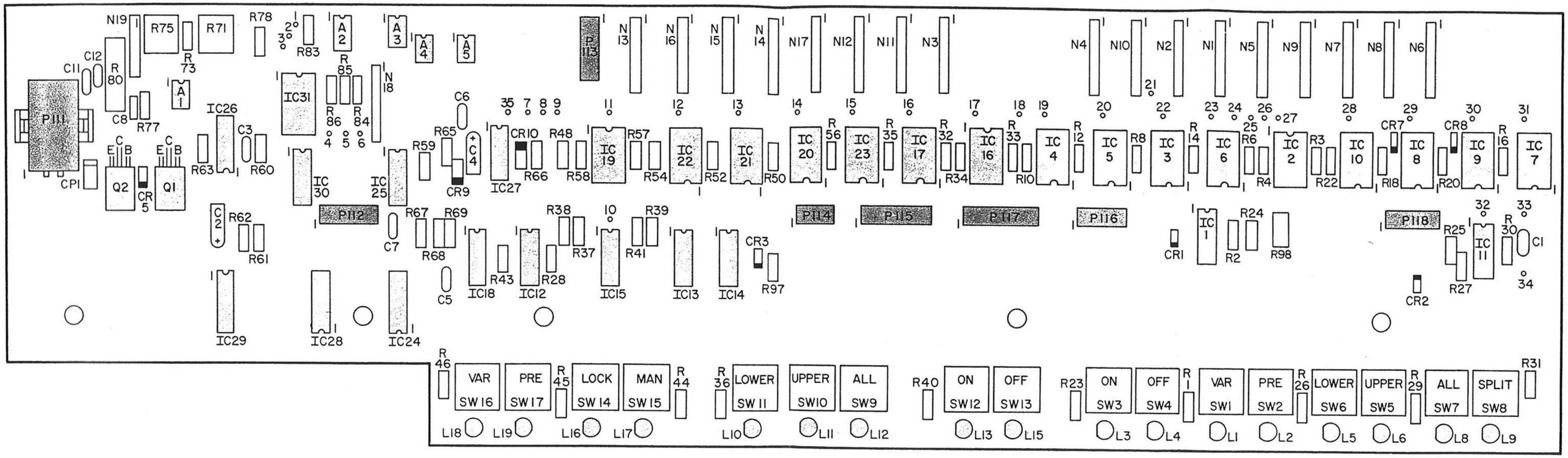
FUTURE RESISTOR VALUES

N	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10
N1										
N2										
N3										
N4										
N5										
N6										
N7										
N8										
N9										
N10										
N11										
N12										
N13										
N14										
N15										
N16										
N17										

NETWORK RESISTOR VALUES FOR INSTRUMENTS BELOW SERIAL NO. 3000

N	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10
N1	33K						51K			
N2	3.3M				100K		150K			
N3	62K	270K	200K	150K	100K	270K	160K	200K		
N4	20K	16K	13K	30K	15K	13K				
N5					30K					
N6		27K	24K	360K		24K	24K	33K		
N7	1M	110K	1M	110K		240K	9.1K	33K		
N8	620K	820K	1M	180K		510K	150K	300K		
N9		18K	27K	18K		16K	33K	16K		
N10	12K	16K	16K	18K	15K	15K	15K	18K		
N11	82K	270K	91K	10K	240K	51K	240K			
N12	75K	300K	75K	75K	75K	120K	240K	75K		
N13	150K	130K	110K	36K	36K	130K	150K	130K		
N14	120K	36K		33K	56K	39K	47K	39K		
N15	110K	36K		33K	56K	39K	47K	39K		
N16	100K		330K					390K		
N17	110K		130K		390K		510K	240K		

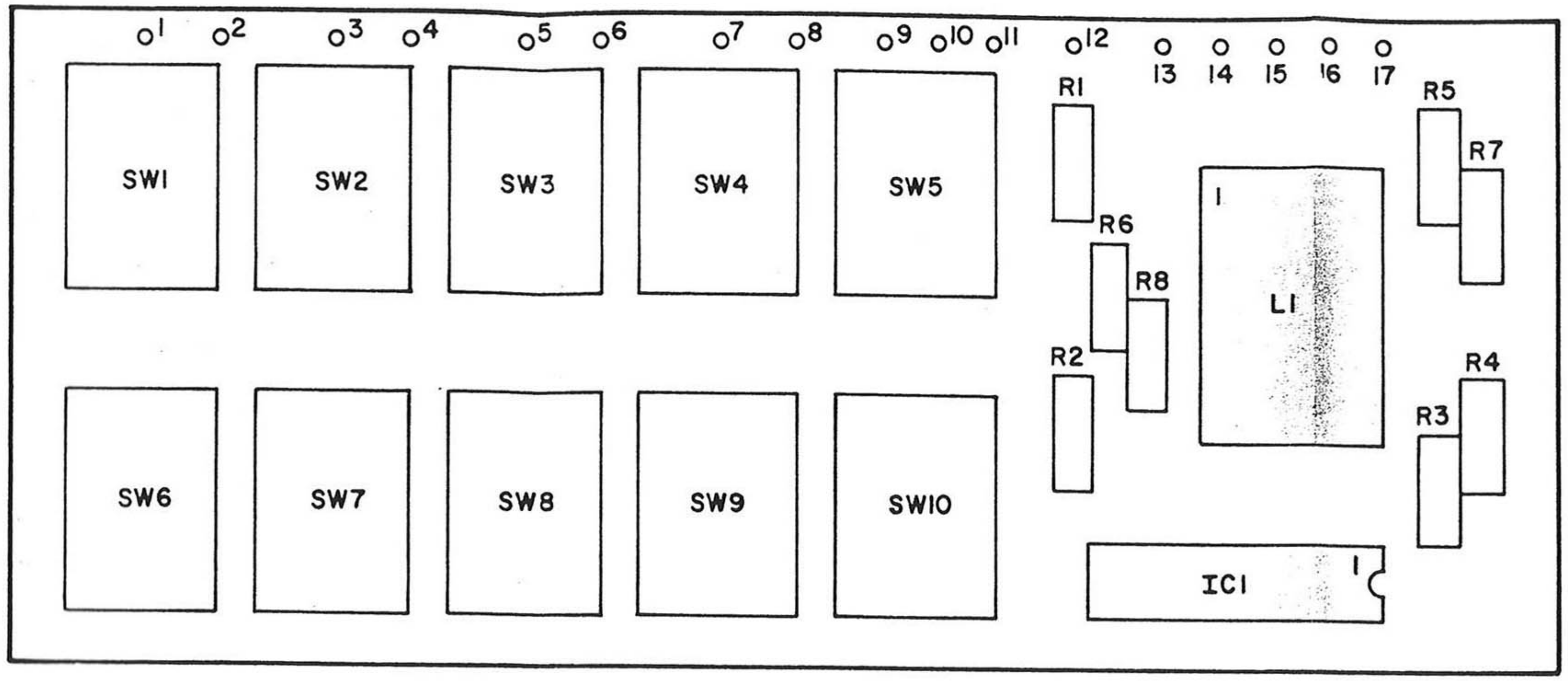
996-040165
CR BOARD 11


P111
Q2
Q1
CR5
CP1
C11
C12
R80
C8
R77
N19
R75
R71
R73
A1
R78
R83
A2
A3
A4
A5
IC26
C3
R63
R60
C2
R62
R61
IC31
R85
R86
R84
N18
IC30
IC25
P112
C6
R65
C4
R59
CR9
CR10
R66
C7
R67
R69
R68
C5
IC29
IC28
IC24
IC27
R48
R58
P113
N13
N16
N15
N14
N17
N12
N11
N3
N4
N10
N2
N1
N5
N9
N7
N8
N6
IC19
IC22
IC21
IC20
IC23
IC17
IC16
IC4
IC5
IC3
IC6
IC2
IC10
IC8
IC9
IC7
R57
R54
R52
R50
R56
R35
R32
R34
R33
R10
R12
R8
R14
R6
R4
R3
R22
CR7
R18
CR8
R20
R16
P114
P115
P117
P116
P118
R38
R37
R39
R41
R43
R28
IC18
IC12
IC15
IC13
IC14
CR3
R97
IC1
CR1
R24
R2
R98
R25
IC11
R30
C1
R27
CR2
R46
VAR SW16
PRE SW17
R45
LOCK SW14
MAN SW15
R44
R36
LOWER SW11
UPPER SW10
ALL SW9
R40
ON SW12
OFF SW13
R23
ON SW3
OFF SW4
R1
VAR SW1
PRE SW2
R26
LOWER SW6
UPPER SW5
R29
ALL SW7
SPLIT SW8
R31
L18
L19
L16
L17
L10
L11
L12
L13
L15
L3
L4
L1
L2
L5
L6
L8
L9

REV	DESCRIPTION	EO
A	REVISED AND RELEASED FOR PRODUCTION	0192
B	ADD DIODES AND REMOVE RESISTOR	0233
C	CHANGER PER EO 0262	0262
D	CHANGE R56 FROM 100K TO 150K	0294
E	CHANGE N2-PIN WAS -001. R5 WAS 200K	0291
F	CHANGED CONNECTOR CALLOUT FROM P78-4 TO P78-3	0359
G	REVISED - CIRCUITRY, R49 AND R51 SLIDE POTS AND RESISTOR NETWORKS. ADDED R98 100K RESISTOR	0651
H	CHANGED R49 AND R51 SLIDE POTS FROM 10K REV TO 10K LIN. DELETED R2 (300K) AND R6 (120K) FROM N12	0687
J	NEXT ASSEMBLY WAS 981-040163	0790
K	P83-5 WAS P83-7	1120

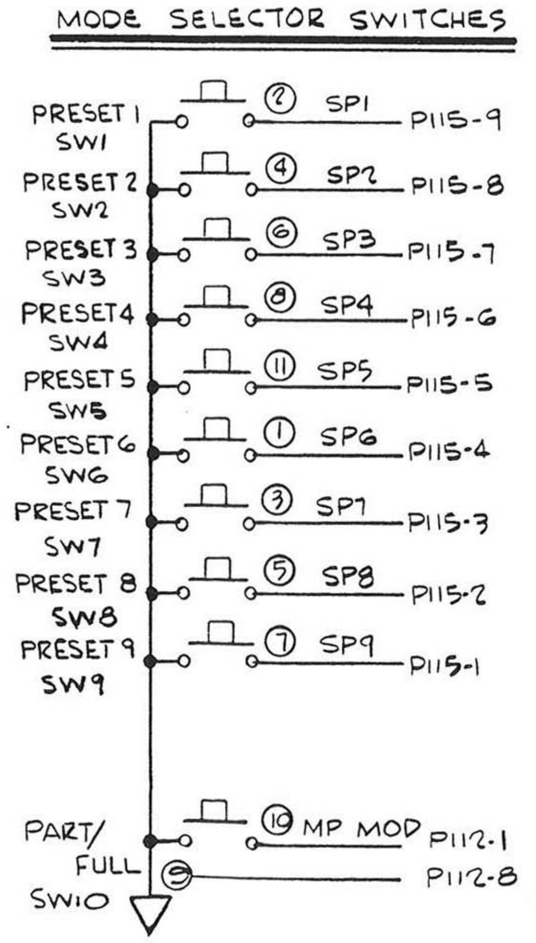
996-040165
CR BOARD 11

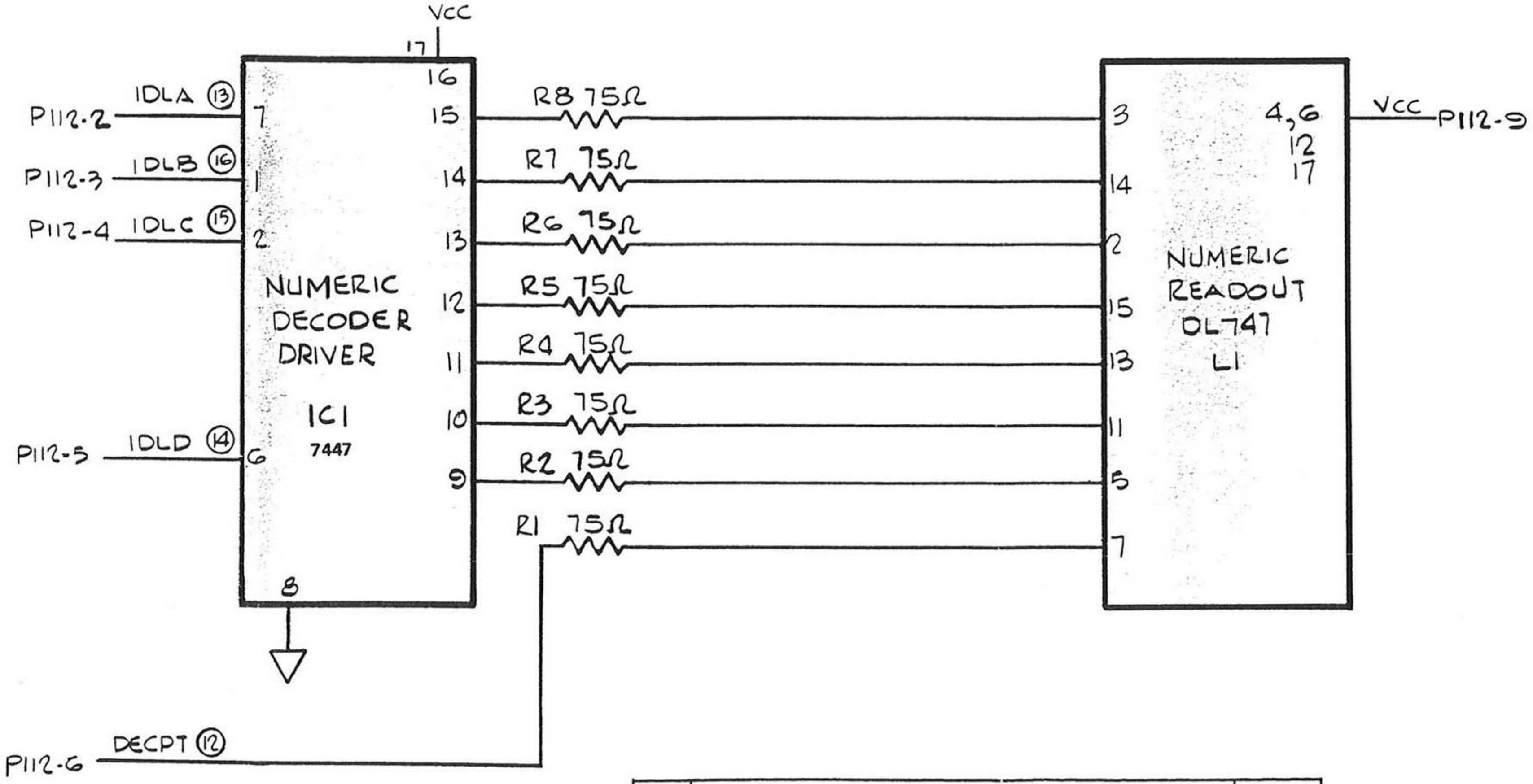
RIGHT HAND CONTROL PANEL AND MASTER PRESET PRINTED CIRCUIT CR BOARD 11 ASSEMBLY


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
SW1
SW2
SW3
SW4
SW5
SW6
SW7
SW8
SW9
SW10
R1
R2
R3
R4
R5
R6
R7
R8
L1
1
IC1
1

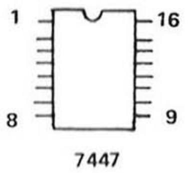
NOTES:
1. REFER TO THE REPLACEMENT PARTS LIST IN VOLUME 1, SECTION 7 FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.
2. CONNECTOR DESIGNATORS INCLUDE A CODED REFERENCE PERTAINING TO ITS PRINTED CIRCUIT BOARD ORIGIN, I.E., P115 INDICATES IT IS PART OF BOARD 11. REFER TO TABLE 1-1 FOR OTHER BOARD NUMBERS AND NOMENCLATURE.

NOTES:
UNLESS OTHERWISE SPECIFIED -
1. ALL RESISTOR VALUES ARE IN OHMS 1/4W, ±5%.
2. O DENOTES WIRE NUMBER.


MODE SELECTOR SWITCHES
PRESET 1 SW1
② SP1
P115-9
PRESET 2 SW2
④ SP2
P115-8
PRESET 3 SW3
⑥ SP3
P115-7
PRESET4 SW4
⑧ SP4
P115-6
PRESET 5 SW5
⑪ SP5
P115-5
PRESET 6 SW6
① SP6
P115-4
PRESET 7 SW7
③ SP7
P115-3
PRESET 8 SW8
⑤ SP8
P115-2
PRESET 9 SW9
⑦ SP9
P115-1
PART/ FULL SW10
⑲ MP MOD
P112-1
⑨
P112-8


VCC
17
16
P112-2
IDLA ⑬
7
P112-3
IDLB ⑯
1
P112-4
IDLC ⑮
2
P112-5
IDLD ⑭
6
NUMERIC DECODER DRIVER
IC1
7447
8
15
14
13
12
11
10
9
R8 75Ω
R7 75Ω
R6 75Ω
R5 75Ω
R4 75Ω
R3 75Ω
R2 75Ω
R1 75Ω
P112-6
DECPT ⑫
3
14
2
15
13
11
5
7
4,6
12
17
NUMERIC READOUT DL747
L1
VCC
P112-9

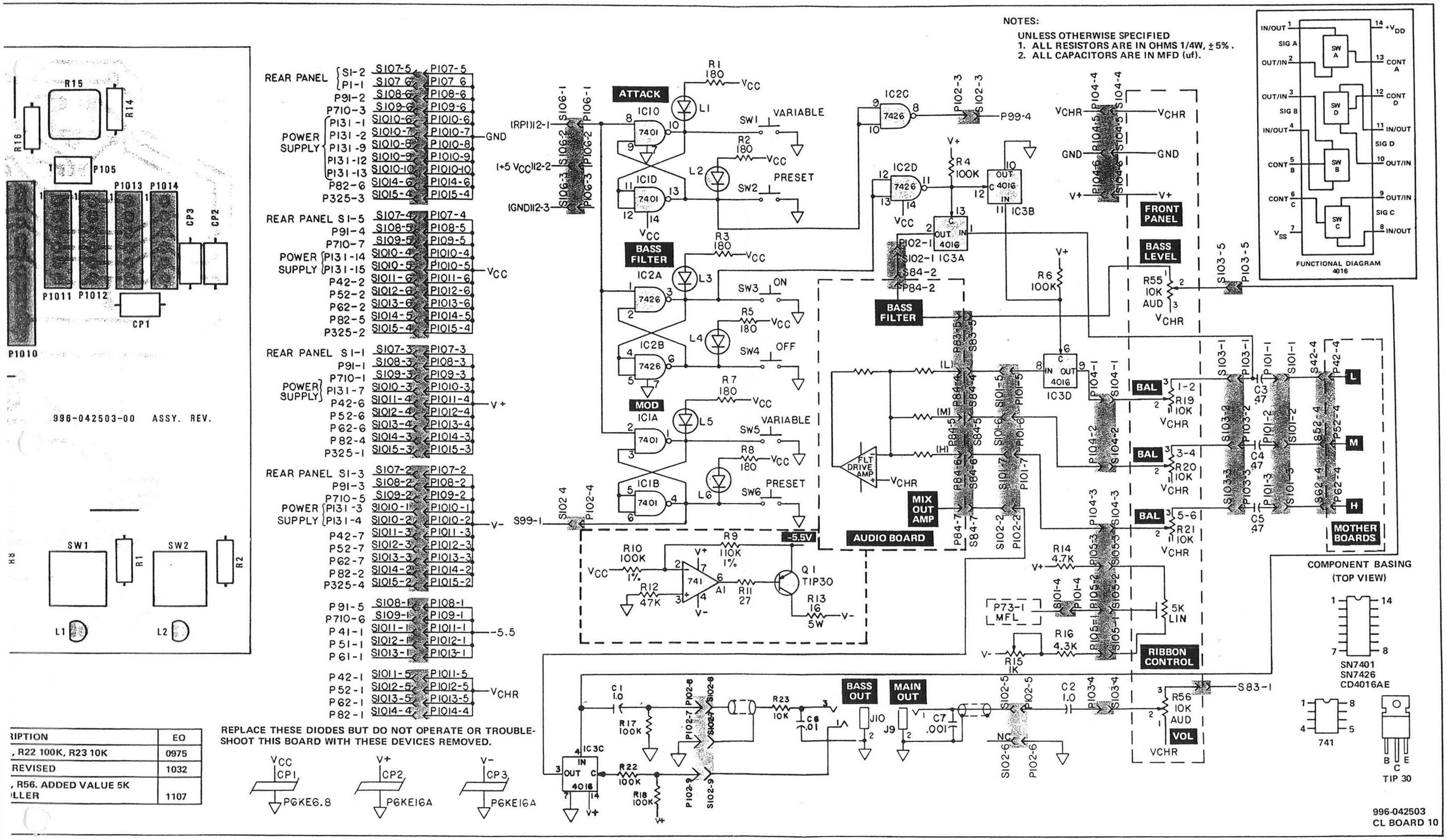
COMPONENT BASING
(TOP VIEW)



REV.	DESCRIPTION	EO
A	RELEASED FOR PRODUCTION	0192
B	NEXT ASSEMBLY WAS 981-040150	0790

996-040161
MODE BOARD 12

MODE SELECTOR SCHEMATIC DIAGRAM MODE BOARD 12

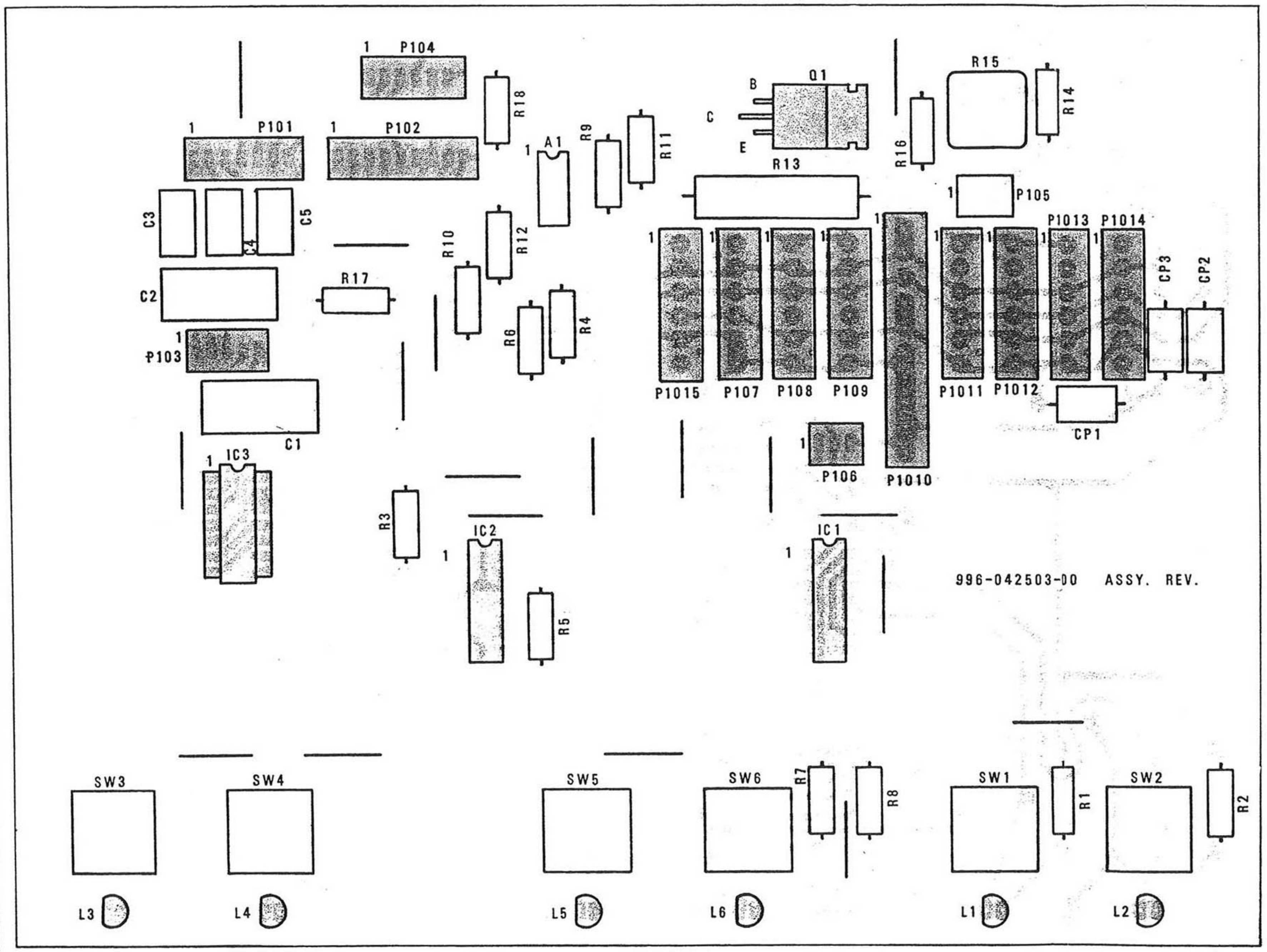

REAR PANEL
POWER SUPPLY
GND
VCC
V+
V-
-5.5
VCHR
S99-1
(RP1)12-1
(+5 VCC)12-2
(GND)12-3
ATTACK
BASS FILTER
MOD
IC1C 7401
IC1D 7401
IC2A 7426
IC2B 7426
IC1A 7401
IC1B 7401
IC2C 7426
IC2D 7426
IC3A 4016
IC3B 4016
IC3C 4016
IC3D 4016
SW1 VARIABLE
SW2 PRESET
SW3 ON
SW4 OFF
SW5 VARIABLE
SW6 PRESET
L1
L2
L3
L4
L5
L6
R1 180
R2 180
R3 180
R5 180
R7 180
R8 180
R4 100K
R6 100K
P99-4
-5.5V
R9 110K 1%
R10 100K 1%
R12 47K
R11 27
R13 16 5W
Q1 TIP30
741 A1
AUDIO BOARD
FLT DRIVE AMP
MIX OUT AMP
FRONT PANEL
BASS LEVEL
R55 10K AUD
BAL
R19 10K
R20 10K
R21 10K
C3 .47
C4 .47
C5 .47
MOTHER BOARDS
L
M
H
R14 4.7K
R15 1K
R16 4.3K
5K LIN
P73-1 MFL
RIBBON CONTROL
S83-1
R56 10K AUD
VOL
BASS OUT
MAIN OUT
C1 1.0
C2 1.0
R17 100K
R18 100K
R22 100K
R23 10K
C6 .01
C7 .001
J10
J9
CP1 P6KE6.8
CP2 P6KE16A
CP3 P6KE16A
996-042503-00 ASSY. REV.
FUNCTIONAL DIAGRAM 4016
COMPONENT BASING (TOP VIEW)
SN7401
SN7426
CD4016AE
741
TIP 30
996-042503
CL BOARD 10

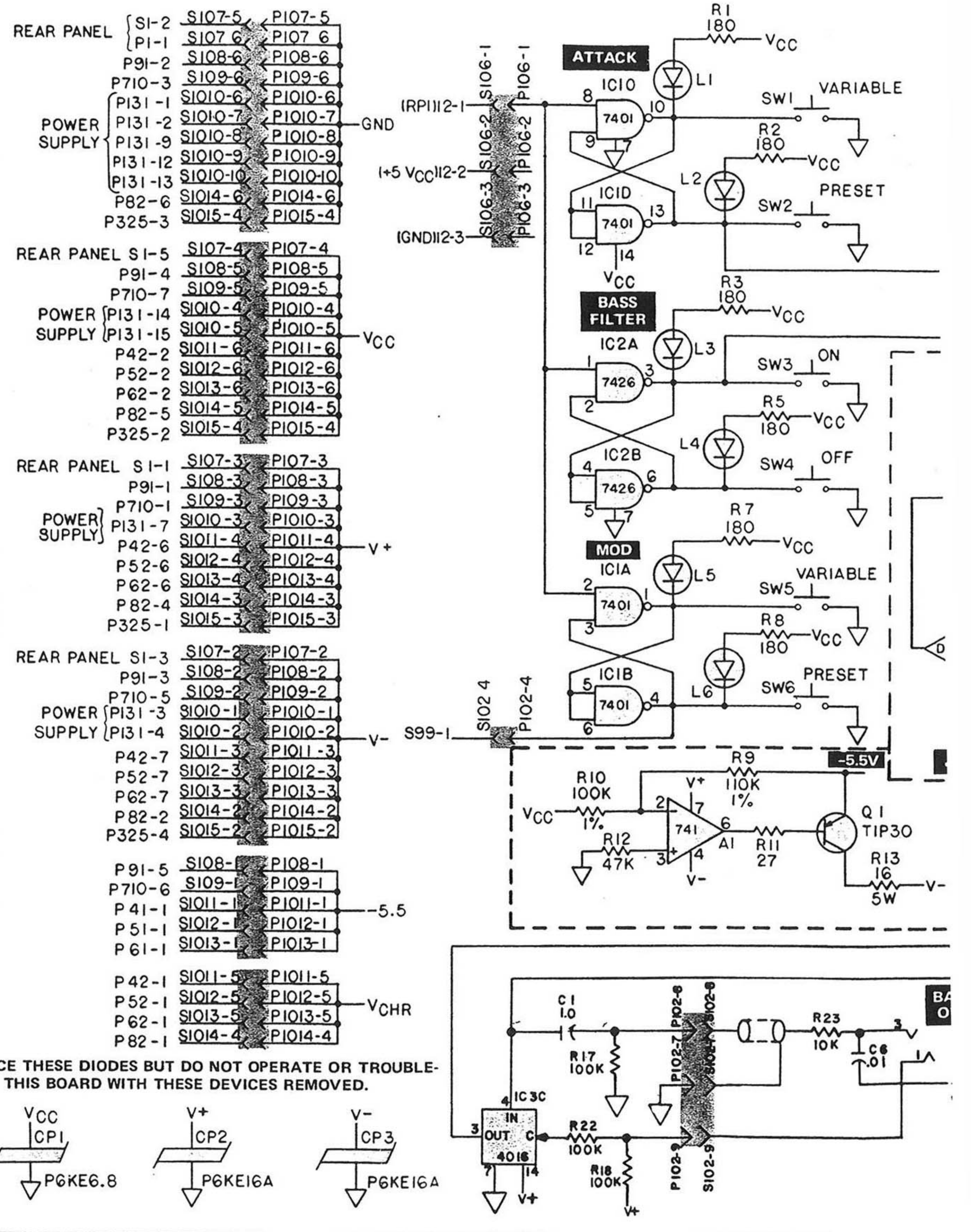
NOTES:
UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS ARE IN OHMS 1/4W, ±5%.
2. ALL CAPACITORS ARE IN MFD (uf).

REPLACE THESE DIODES BUT DO NOT OPERATE OR TROUBLESHOOT THIS BOARD WITH THESE DEVICES REMOVED.

IPTION	EO
, R22 100K, R23 10K	0975
REVISED	1032
, R56. ADDED VALUE 5K LLER	1107

LEFT HAND CONTROL PANEL SCHEMATIC DIAGRAM CL BOARD 10 (POLYMOOG KEYBOARD)


P104
P101
P102
Q1
B
C
E
R15
R14
R18
A1
R9
R11
R13
R16
P105
C3
C4
C5
R10
R12
R17
C2
P103
R6
R4
C1
IC3
P1015
P107
P108
P109
P1010
P1011
P1012
P1013
P1014
CP3
CP2
CP1
P106
R3
IC2
IC1
R5
996-042503-00 ASSY. REV.
SW3
SW4
SW5
SW6
R7
R8
SW1
R1
SW2
R2
L3
L4
L5
L6
L1
L2

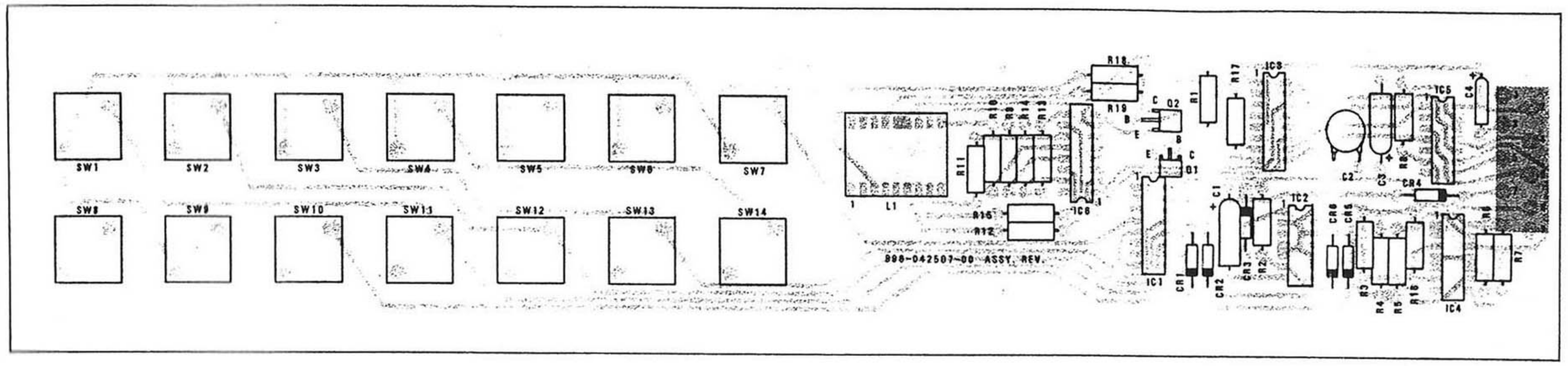

REAR PANEL S1-2 S107-5 P107-5
P1-1 S107-6 P107-6
P91-2 S108-6 P108-6
P710-3 S109-6 P109-6
POWER SUPPLY P131-1 S1010-6 P1010-6
P131-2 S1010-7 P1010-7 GND
P131-9 S1010-8 P1010-8
P131-12 S1010-9 P1010-9
P131-13 S1010-10 P1010-10
P82-6 S1014-6 P1014-6
P325-3 S1015-4 P1015-4
REAR PANEL S1-5 S107-4 P107-4
P91-4 S108-5 P108-5
P710-7 S109-5 P109-5
POWER SUPPLY P131-14 S1010-4 P1010-4
P131-15 S1010-5 P1010-5 VCC
P42-2 S1011-6 P1011-6
P52-2 S1012-6 P1012-6
P62-2 S1013-6 P1013-6
P82-5 S1014-5 P1014-5
P325-2 S1015-4 P1015-4
REAR PANEL S1-1 S107-3 P107-3
P91-1 S108-3 P108-3
P710-1 S109-3 P109-3
POWER SUPPLY P131-7 S1010-3 P1010-3
P42-6 S1011-4 P1011-4 V+
P52-6 S1012-4 P1012-4
P62-6 S1013-4 P1013-4
P82-4 S1014-3 P1014-3
P325-1 S1015-3 P1015-3
REAR PANEL S1-3 S107-2 P107-2
P91-3 S108-2 P108-2
P710-5 S109-2 P109-2
POWER SUPPLY P131-3 S1010-1 P1010-1
P131-4 S1010-2 P1010-2 V-
P42-7 S1011-3 P1011-3
P52-7 S1012-3 P1012-3
P62-7 S1013-3 P1013-3
P82-2 S1014-2 P1014-2
P325-4 S1015-2 P1015-2
P91-5 S108-1 P108-1
P710-6 S109-1 P109-1
P41-1 S1011-1 P1011-1 -5.5
P51-1 S1012-1 P1012-1
P61-1 S1013-1 P1013-1
P42-1 S1011-5 P1011-5
P52-1 S1012-5 P1012-5 VCHR
P62-1 S1013-5 P1013-5
P82-1 S1014-4 P1014-4
(RPI)12-1
(+5 VCC)12-2
(GND)12-3
S106-1
P106-1
S106-2
P106-2
S106-3
P106-3
ATTACK
IC1C
7401
IC1D
R1 180
VCC
L1
SW1 VARIABLE
R2 180
L2
SW2 PRESET
BASS FILTER
IC2A
7426
IC2B
R3 180
L3
SW3 ON
R5 180
L4
SW4 OFF
MOD
IC1A
IC1B
R7 180
L5
SW5 VARIABLE
R8 180
L6
SW6 PRESET
S102-4
P102-4
S99-1
-5.5V
R9 110K 1%
R10 100K 1%
R12 47K
741
A1
V+
V-
R11 27
Q1 TIP30
R13 16 5W
C1 1.0
R17 100K
IC3C
IN
OUT
C
4016
R22 100K
R18 100K
P102-8
S102-8
P102-7
P102-9
S102-9
R23 10K
C6 .01
VCC CP1 P6KE6.8
V+ CP2 P6KE16A
V- CP3 P6KE16A

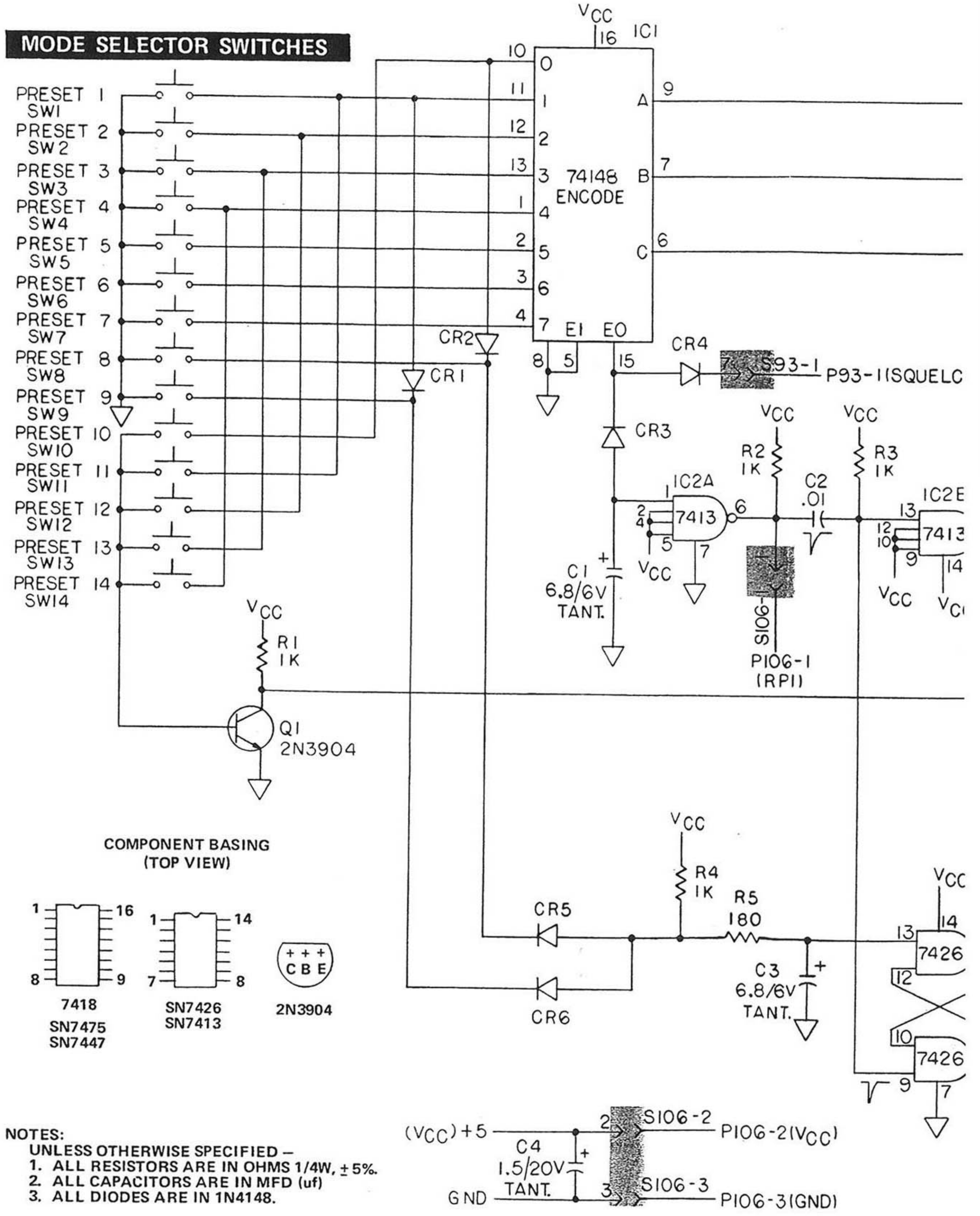
REPLACE THESE DIODES BUT DO NOT OPERATE OR TROUBLESHOOT THIS BOARD WITH THESE DEVICES REMOVED.

NOTE:
REFER TO THE REPLACEMENT PARTS LIST IN VOLUME 1, SECTION 7 FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.

REV.	DESCRIPTION	EO
A	RELEASED FOR PRODUCTION	0551
B	NEXT ASSEMBLY WAS 981-042501	0790
C	SLIDE POTS RENUMBERED	0910
D	REVERSED PIN NO'S. S101-2, S101-3 AND S103-2, S103-3	0935

REV.	DESCRIPTION	EO
E	ADDED C6 0.01, C7 0.001, R22 100K, R23 10K	0975
F	ADDED S102-6, PIN NO'S REVISED	1032
G	ADDED REF. DESIG. R55, R56. ADDED VALUE 5K LIN TO RIBBON CONTROLLER	1107


SW1
SW2
SW3
SW4
SW5
SW6
SW7
SW8
SW9
SW10
SW11
SW12
SW13
SW14
L1
IC1
IC2
IC3
IC4
IC5
IC6
Q1
Q2
CR1
CR2
CR3
CR4
C1
C2
C3
C4
R1
R2
R3
R4
R5
R6
R7
R11
R12
R13
R14
R15
R16
R17
R18
R19
998-042507-00 ASSY. REV.

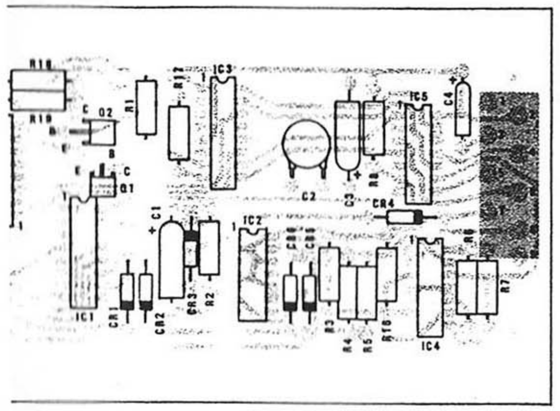

MODE SELECTOR SWITCHES
PRESET 1 SW1
PRESET 2 SW2
PRESET 3 SW3
PRESET 4 SW4
PRESET 5 SW5
PRESET 6 SW6
PRESET 7 SW7
PRESET 8 SW8
PRESET 9 SW9
PRESET 10 SW10
PRESET 11 SW11
PRESET 12 SW12
PRESET 13 SW13
PRESET 14 SW14
VCC
IC1
74148 ENCODE
A
B
C
EI
EO
CR1
CR2
CR3
CR4
S93-1
P93-1(SQUELC
R1 1K
Q1 2N3904
R2 1K
R3 1K
IC2A
7413
IC2B
C1 6.8/6V TANT.
C2 .01
S106-1
P106-1 (RP1)
R4 1K
R5 180
CR5
CR6
C3 6.8/6V TANT.
7426
COMPONENT BASING (TOP VIEW)
7418
SN7475
SN7447
SN7426
SN7413
2N3904
C B E
(VCC) +5
GND
C4 1.5/20V TANT.
S106-2
P106-2(VCC)
S106-3
P106-3(GND)

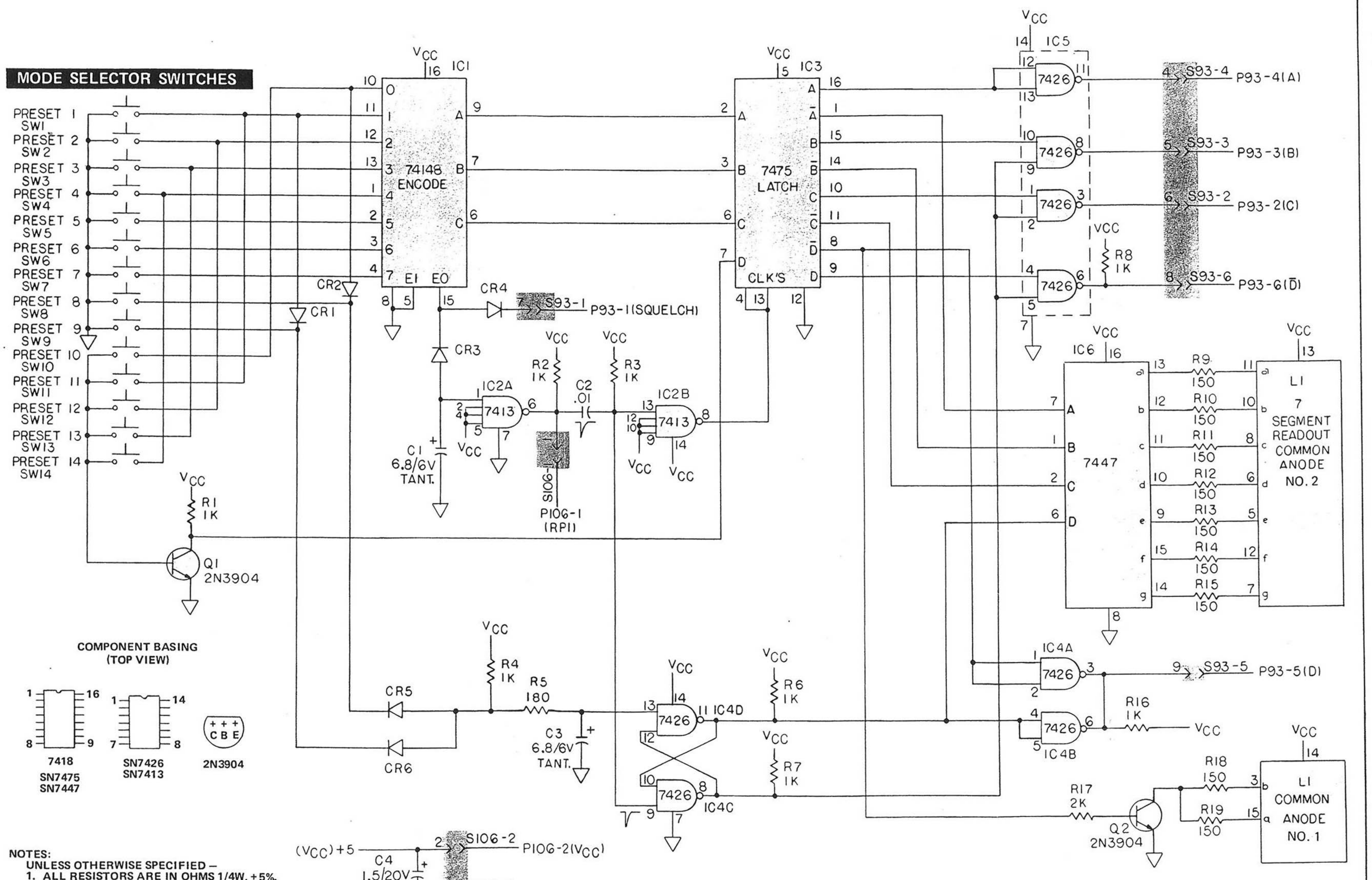
NOTE:
REFER TO THE REPLACEMENT PARTS LIST IN VOLUME 1, SECTION 7
FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.

REV.	DESCRIPTION	EO
A	RELEASED FOR PRODUCTION	0551
B	NEXT ASSEMBLY WAS 981-042505	0790

NOTES:
UNLESS OTHERWISE SPECIFIED –
1. ALL RESISTORS ARE IN OHMS 1/4W, ± 5%.
2. ALL CAPACITORS ARE IN MFD (uf)
3. ALL DIODES ARE IN 1N4148.

MASTER VOICE SELECTOR SCHEMATIC DIAGRAM MODE BOARD 12




MODE SELECTOR SWITCHES
PRESET 1 SW1
PRESET 2 SW2
PRESET 3 SW3
PRESET 4 SW4
PRESET 5 SW5
PRESET 6 SW6
PRESET 7 SW7
PRESET 8 SW8
PRESET 9 SW9
PRESET 10 SW10
PRESET 11 SW11
PRESET 12 SW12
PRESET 13 SW13
PRESET 14 SW14
VCC
IC1
74148 ENCODE
EI
EO
CR1
CR2
CR3
CR4
S93-1
P93-1(SQUELCH)
IC3
7475 LATCH
CLK'S
IC5
7426
S93-4
P93-4(A)
S93-3
P93-3(B)
S93-2
P93-2(C)
S93-6
P93-6(D̄)
R8 1K
IC2A
7413
R2 1K
C2 .01
R3 1K
IC2B
C1 6.8/6V TANT.
S106-1
P106-1 (RP1)
IC6
7447
R9 150
R10 150
R11 150
R12 150
R13 150
R14 150
R15 150
L1 7 SEGMENT READOUT COMMON ANODE NO. 2
R1 1K
Q1 2N3904
IC4A
7426
S93-5
P93-5(D)
R16 1K
IC4B
R4 1K
R5 180
CR5
CR6
C3 6.8/6V TANT.
IC4D
R6 1K
R7 1K
IC4C
R17 2K
Q2 2N3904
R18 150
R19 150
L1 COMMON ANODE NO. 1
(VCC)+5
C4 1.5/20V TANT.
GND
S106-2
P106-2(VCC)
S106-3
P106-3(GND)
COMPONENT BASING (TOP VIEW)
7418
SN7475
SN7447
SN7426
SN7413
2N3904
C B E

RTS LIST IN VOLUME 1, SECTION 7
CRIPTION OF EACH REFERENCE DESIGNATOR.

DESCRIPTION	EO
PRODUCTION	0551
Y WAS 981-042505	0790

NOTES:
UNLESS OTHERWISE SPECIFIED –
1. ALL RESISTORS ARE IN OHMS 1/4W, ± 5%.
2. ALL CAPACITORS ARE IN MFD (uf)
3. ALL DIODES ARE IN 1N4148.

996-042507
MODE BOARD 12

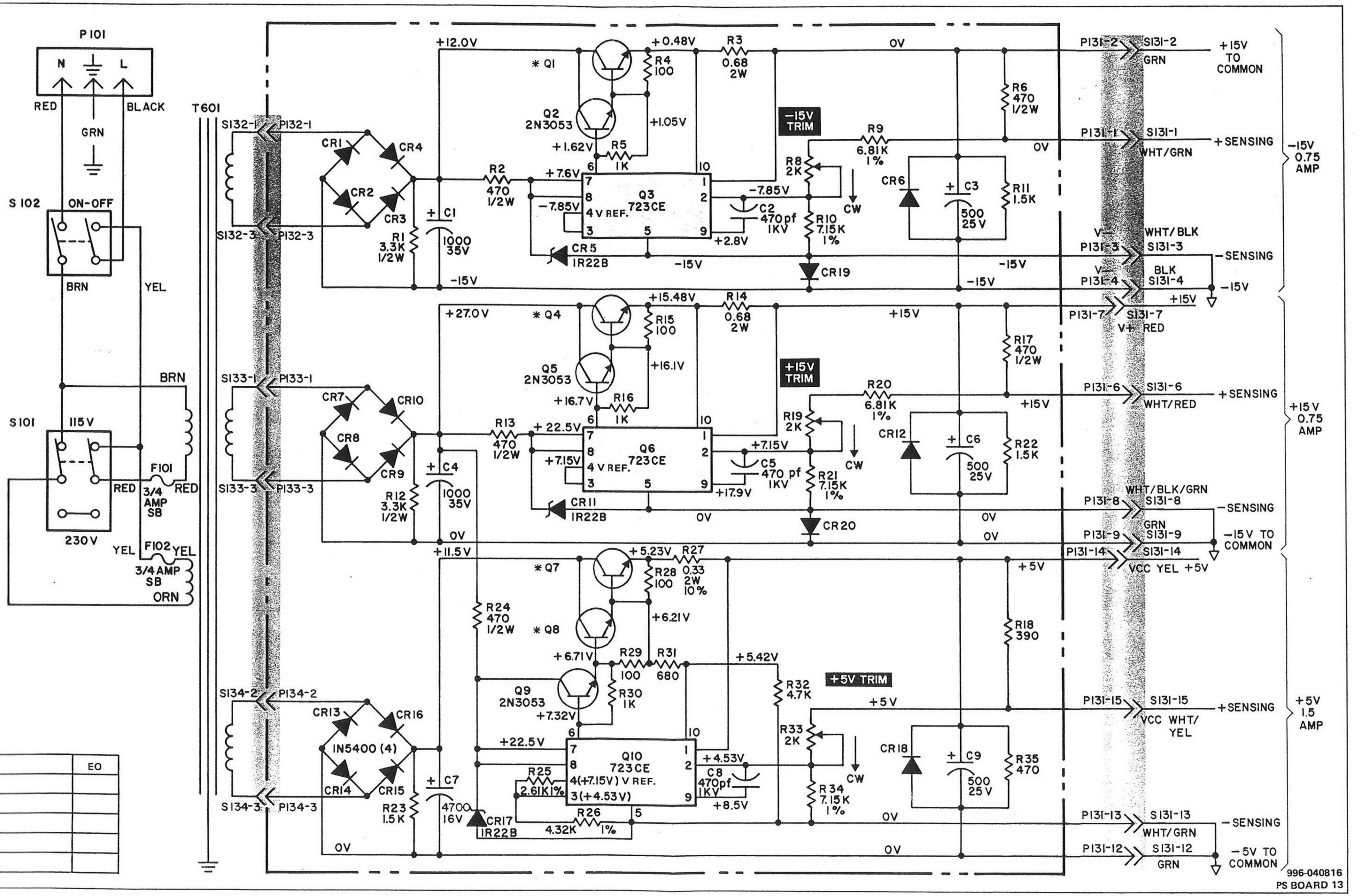
E REPLACEMENT
ǀ VOL. 1, SECTION 8
T NUMBER AND DE-
: EACH REFERENCE
.
:RWISE SPECIFIED:
R VALUES ARE IN
LUES ARE IN

ARE 1N4002.
AKEN WITH COMMON
NALS TIED TOGETHER,
UTPUTS LOADED TO
OUTPUT LOADED TO
AC INPUT, AND SENSE
CTED TO POWER

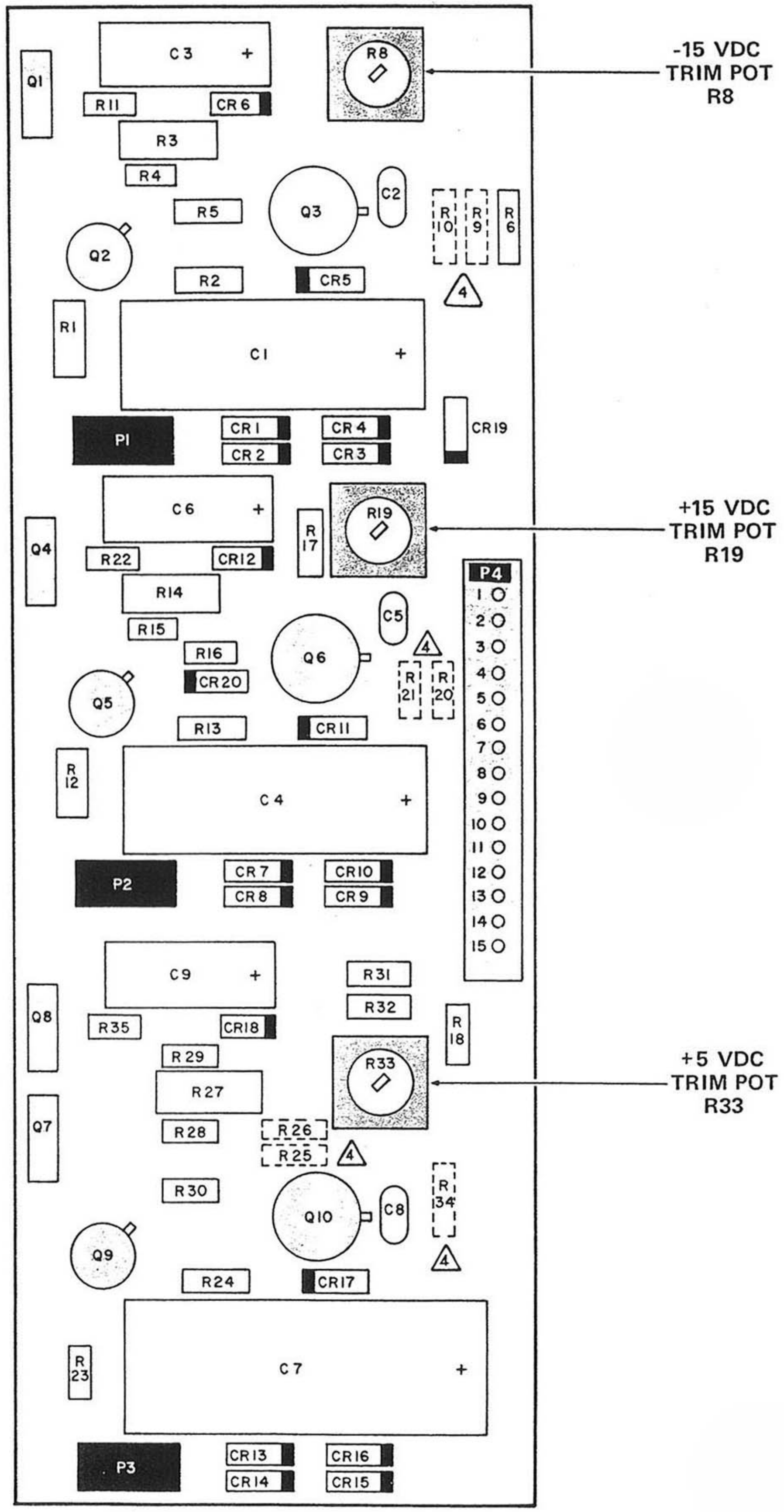
'ART LOCATION IF
VARIABLE RESISTOR
3.
POWER SUPPLIES ARE

.
'INS 2, 9, 12, AND 13
(ALL GREEN AND
EEN WIRES).
F THERE ARE OUTPUT
.
IENTS WILL VARY FROM
BUT WILL INDICATE IF
ARE FUNCTIONING.

DESCRIPTION	EO


P101
N
L
RED
BLACK
GRN
S 102
ON-OFF
BRN
YEL
S101
115V
230V
BRN
RED
F101
3/4 AMP SB
RED
YEL
F102
YEL
3/4 AMP SB
ORN
T601
S132-1
P132-1
S132-3
P132-3
S133-1
P133-1
S133-3
P133-3
S134-2
P134-2
S134-3
P134-3
CR1
CR2
CR3
CR4
CR7
CR8
CR9
CR10
CR13
CR14
CR15
CR16
IN5400 (4)
R1 3.3K 1/2W
C1 1000 35V
R12 3.3K 1/2W
C4 1000 35V
R23 1.5K
C7 4700 16V
+12.0V
-15V
+27.0V
0V
+11.5V
∗ Q1
Q2 2N3053
+0.48V
R4 100
+1.05V
+1.62V
R5 1K
R2 470 1/2W
+7.6V
-7.85V
Q3 723CE
4 V REF.
CR5 IR22B
R3 0.68 2W
-15V TRIM
R9 6.81K 1%
R8 2K
-7.85V
C2 470pf 1KV
+2.8V
R10 7.15K 1%
CW
CR19
CR6
C3 500 25V
R6 470 1/2W
R11 1.5K
0V
-15V
∗ Q4
Q5 2N3053
+15.48V
R15 100
+16.1V
+16.7V
R16 1K
R13 470 1/2W
+22.5V
+7.15V
Q6 723CE
4 V REF.
CR11 IR22B
R14 0.68 2W
+15V TRIM
R20 6.81K 1%
R19 2K
+7.15V
C5 470 pf 1KV
+17.9V
R21 7.15K 1%
CR20
CR12
C6 500 25V
R17 470 1/2W
R22 1.5K
+15V
0V
∗ Q7
∗ Q8
Q9 2N3053
+5.23V
R27 0.33 2W 10%
R28 100
+6.21V
+6.71V
R29 100
R31 680
R30 1K
+7.32V
+5.42V
R24 470 1/2W
+22.5V
Q10 723CE
4(+7.15V) V REF.
3(+4.53V)
R25 2.61K 1%
R26 4.32K 1%
CR17 IR22B
+4.53V
C8 470pf 1KV
+8.5V
R32 4.7K
+5V TRIM
R33 2K
R34 7.15K 1%
CR18
C9 500 25V
R18 390
R35 470
+5V
0V
P131-2
S131-2
GRN
+15V TO COMMON
P131-1
S131-1
WHT/GRN
+SENSING
-15V 0.75 AMP
V-
P131-3
WHT/BLK
S131-3
-SENSING
V-
P131-4
BLK
S131-4
-15V
+15V
P131-7
S131-7
V+ RED
P131-6
S131-6
WHT/RED
+SENSING
+15V 0.75 AMP
WHT/BLK/GRN
P131-8
S131-8
-SENSING
P131-9
GRN
S131-9
-15V TO COMMON
P131-14
S131-14
VCC YEL +5V
P131-15
S131-15
VCC WHT/YEL
+SENSING
+5V 1.5 AMP
P131-13
S131-13
WHT/GRN
-SENSING
P131-12
S131-12
GRN
-5V TO COMMON
996-040816
PS BOARD 13

POWER SUPPLY SUBASSEMBLY SCHEMATIC DIAGRAM PS BOARD 13 (FARATRON)

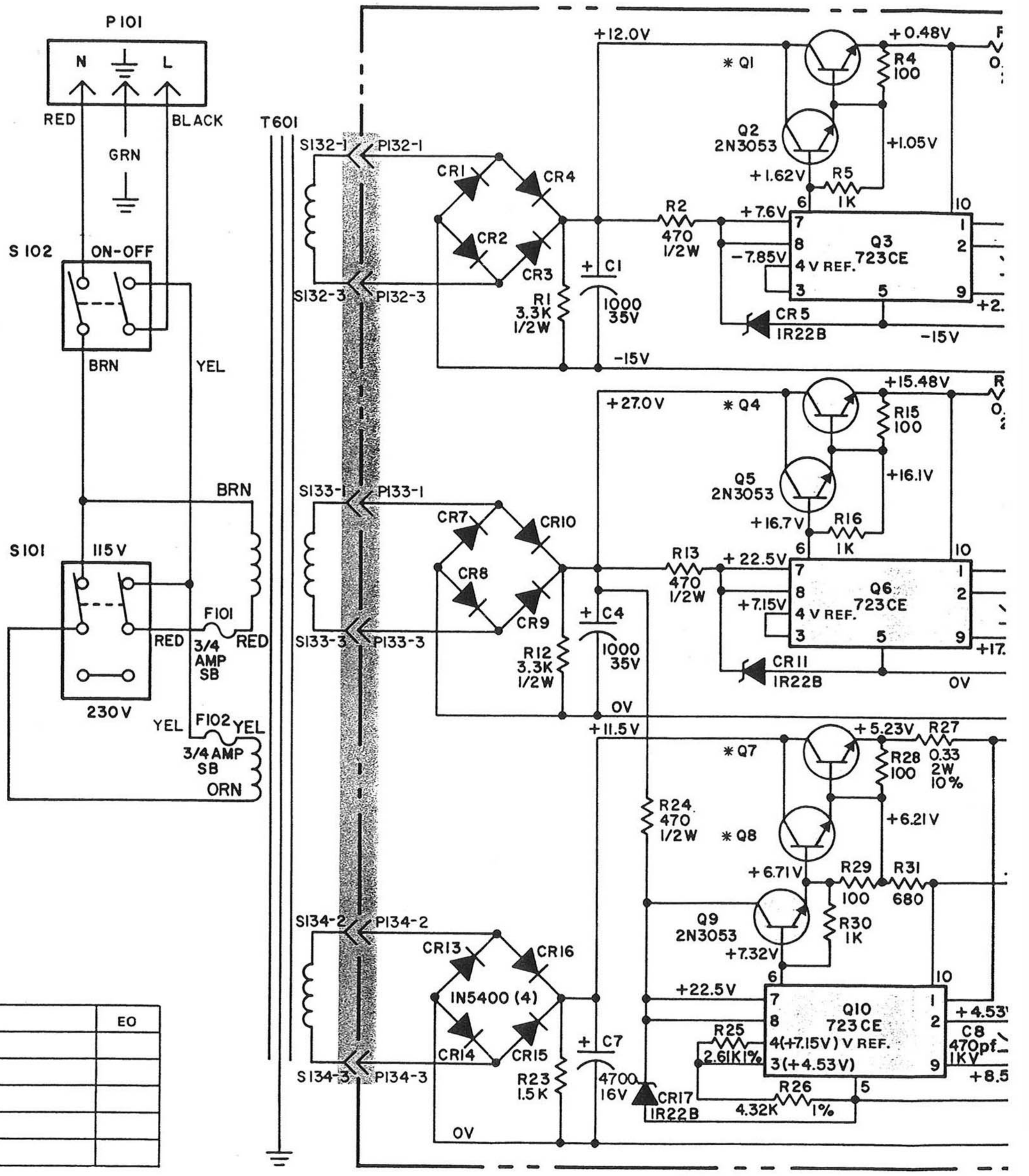


-15 VDC TRIM POT R8
+15 VDC TRIM POT R19
+5 VDC TRIM POT R33
Q1
C3
R8
R11
CR6
R3
R4
R5
Q3
C2
R10
R9
R6
Q2
R2
CR5
R1
C1
P1
CR1
CR2
CR4
CR3
CR19
C6
R19
Q4
R22
CR12
R17
R14
R15
C5
R16
Q6
CR20
R21
R20
Q5
R13
CR11
R12
C4
P2
CR7
CR8
CR10
CR9
P4
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
C9
R31
Q8
R35
CR18
R32
R18
R29
R33
R27
Q7
R28
R26
R25
R30
Q10
C8
R34
Q9
R24
CR17
R23
C7
P3
CR13
CR14
CR16
CR15

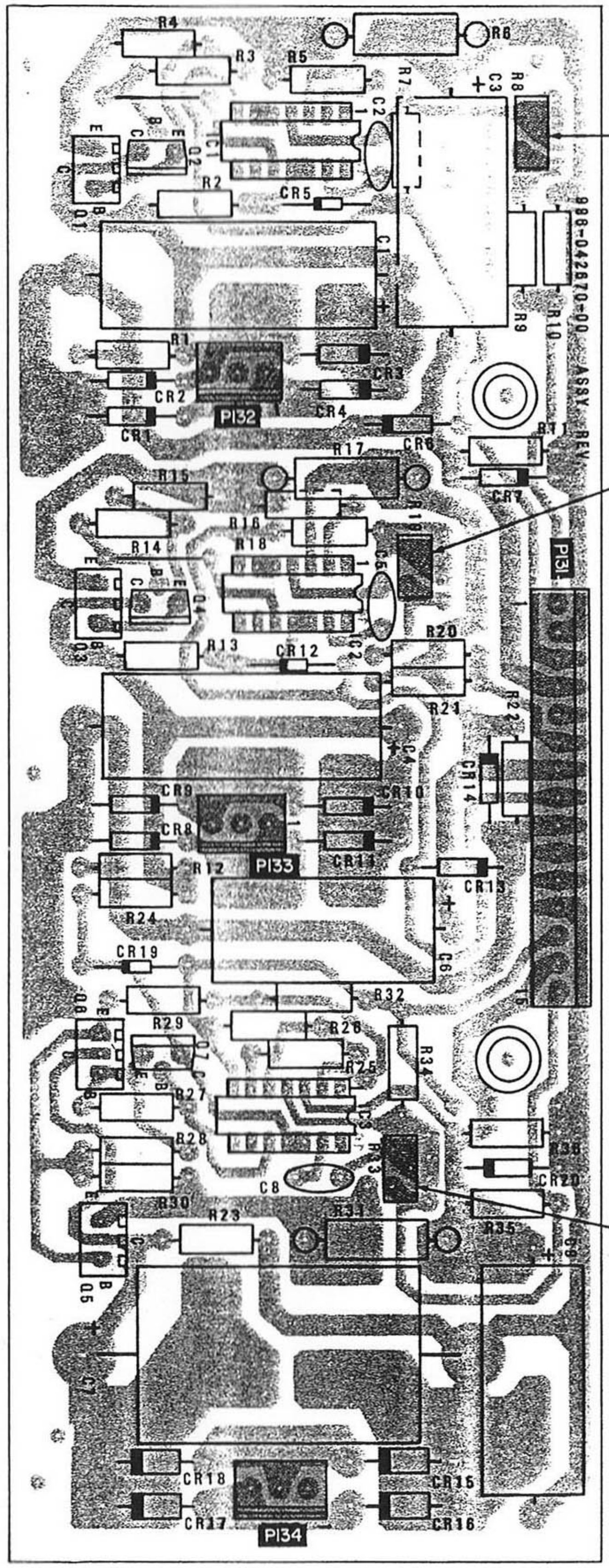
NOTES:

1. REFER TO THE REPLACEMENT PARTS LIST IN VOL. 1, SECTION 8 FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.
2. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTOR VALUES ARE IN OHMS, ±5%, 1/4WATT.
   ALL CAPACITOR VALUES ARE IN MFD (uf).
   ALL DIODES ARE 1N4002.
3. VOLTAGES TAKEN WITH COMMON (REF.) TERMINALS TIED TOGETHER, + AND -15V OUTPUTS LOADED TO 0.7 AMP, +5V OUTPUT LOADED TO 1.5 AMP, 115VAC INPUT, AND SENSE LINES CONNECTED TO POWER LINES.
4. ALTERNATE PART LOCATION IF NOT PART OF VARIABLE RESISTOR R8, R19 OR R33.
5. TO VERIFY IF POWER SUPPLIES ARE OPERATING:
   - UNPLUG P4.
   - CONNECT PINS 2, 9, 12, AND 13 TOGETHER (ALL GREEN AND WHITE/GREEN WIRES).
   - MEASURE IF THERE ARE OUTPUT VOLTAGES.
   - MEASUREMENTS WILL VARY FROM NOMINAL BUT WILL INDICATE IF SUPPLIES ARE FUNCTIONING.

REV	DESCRIPTION	EO



P101
N
L
RED
GRN
BLACK
S102
ON-OFF
BRN
YEL
S101
115V
230V
F101
3/4 AMP SB
F102
3/4 AMP SB
RED
YEL
ORN
T601
S132-1
P132-1
S132-3
P132-3
S133-1
P133-1
S133-3
P133-3
S134-2
P134-2
S134-3
P134-3
CR1
CR2
CR3
CR4
R1 3.3K 1/2W
C1 1000 35V
+12.0V
-15V
R2 470 1/2W
+7.6V
-7.85V
*Q1
Q2 2N3053
+1.62V
R5 1K
R4 100
+0.48V
+1.05V
Q3 723CE
4 V REF.
CR5 1R22B
-15V
CR7
CR8
CR9
CR10
R12 3.3K 1/2W
C4 1000 35V
+27.0V
0V
R13 470 1/2W
+22.5V
+7.15V
*Q4
Q5 2N3053
+16.7V
R16 1K
R15 100
+15.48V
+16.1V
Q6 723CE
4 V REF.
CR11 1R22B
0V
CR13
CR14
CR15
CR16
1N5400 (4)
R23 1.5K
C7 4700 16V
+11.5V
R24 470 1/2W
CR17 1R22B
*Q7
*Q8
+5.23V
R28 100
R27 0.33 2W 10%
+6.21V
+6.71V
R29 100
R31 680
Q9 2N3053
+7.32V
R30 1K
+22.5V
Q10 723CE
4(+7.15V) V REF.
3(+4.53V)
R25 2.61K 1%
R26 4.32K 1%
C8 470pf 1KV
+4.53
+8.5
0V


R4
R3
R5
R6
R7
R8
C3
C2
R2
CR5
998-042670-00 ASSY REV
C1
R9
R10
R1
CR3
CR2
CR1
P132
CR4
CR6
R17
R15
R16
R18
R19
R14
CR7
P131
R13
CR12
R20
C5
R21
R22
C4
CR14
CR9
CR10
CR8
P133
CR11
R12
CR13
R24
C6
CR19
R32
R29
R26
R34
R25
R27
R28
C8
R33
R36
CR20
R30
R23
R31
R35
C9
C7
CR18
CR15
CR17
P134
CR16

-15 VDC TRIM POT R8

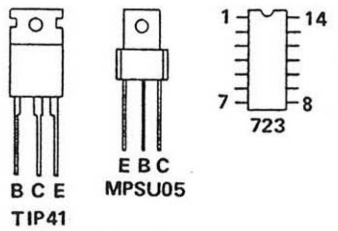
+15 VDC TRIM POT R19

+5 VDC TRIM POT R33

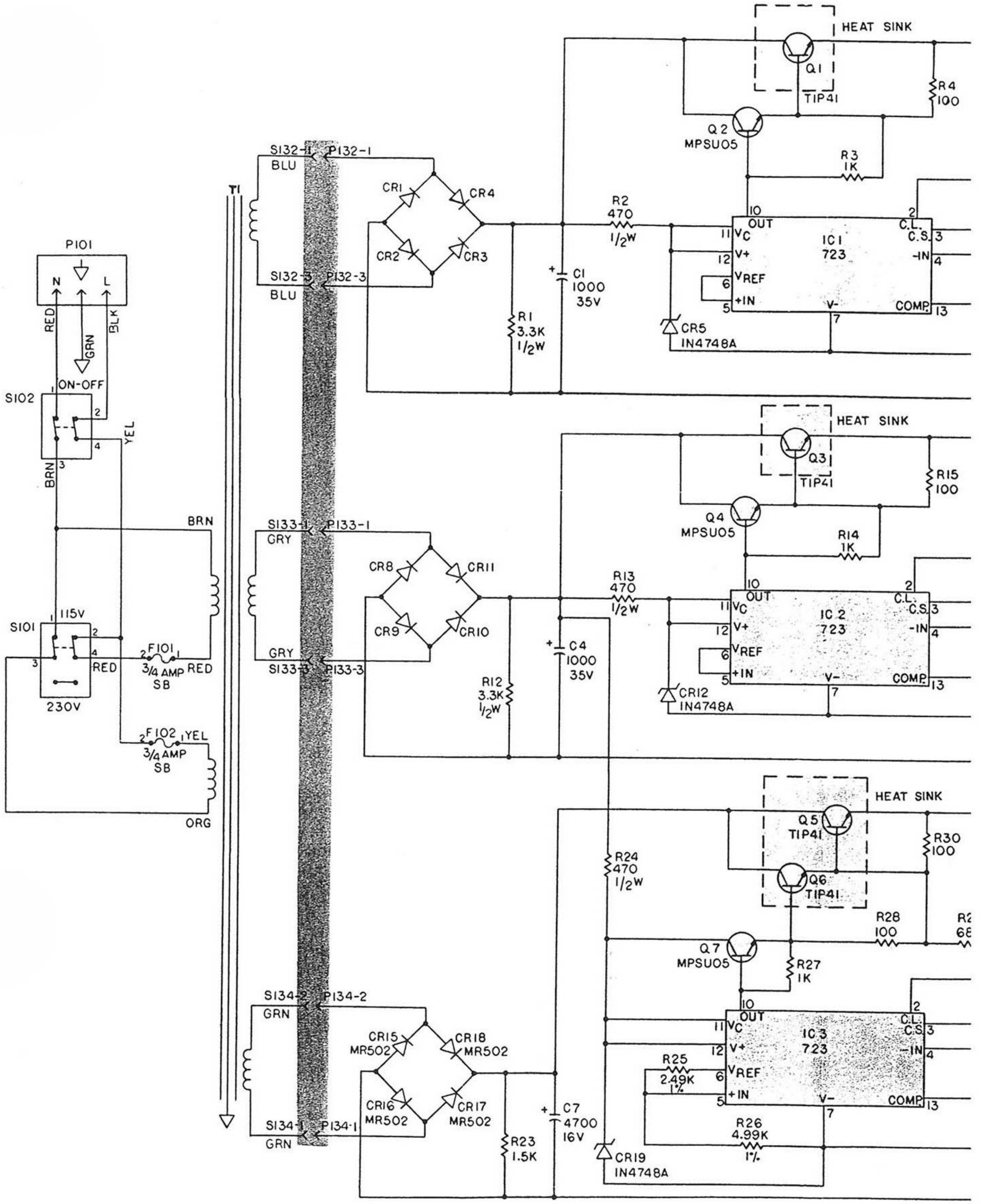
NOTES:

1. REFER TO THE REPLACEMENT PARTS LIST, VOL. 1 SECTION 8 FOR THE PART NUMBER AND DESCRIPTION OF EACH REFERENCE DESIGNATOR.
2. UNLESS OTHERWISE SPECIFIED – ALL RESISTORS ARE IN OHMS 1/4W, ± 5%. ALL CAPACITORS ARE IN MFD (uf). ALL DIODES ARE 1N4004.
3. TO VERIFY IF POWER SUPPLIES ARE OPERATING:
   - UNPLUG P131
   - CONNECT PINS 2, 9, 12 AND 13 TOGETHER (ALL GREEN AND WHITE/GREEN WIRES.)
   - MEASURE IF THERE ARE OUTPUT VOLTAGES.
   - MEASUREMENTS WILL VARY FROM NOMINAL BUT WILL INDICATE IF SUPPLIES ARE FUNCTIONING.
4. INSURE ALL PINS IN P131 ARE FIRMLY SOLDERED.

COMPONENT BASING
(TOP VIEW)


B C E
TIP41
E B C
MPSU05
1
14
7
8
723

REV	DESCRIPTION	EO
A	RELEASED FOR PRODUCTION	0551
B	REVERSE REF DESIG R7, R8, R18, R19	0635
C	NEXT ASSEMBLY WAS 981-042668	0750
D	S134-1, P134-1 WERE S134-3 AND P134-3	1157


HEAT SINK
Q1
TIP41
R4
100
Q2
MPSU05
R3
1K
S132-1
P132-1
BLU
T1
CR1
CR4
CR2
CR3
R2
470
1/2W
10
OUT
11 VC
12 V+
6 VREF
5 +IN
IC1
723
C.L.
C.S.
-IN
COMP
V-
P101
N
L
RED
GRN
BLK
S132-3
P132-3
C1
1000
35V
R1
3.3K
1/2W
CR5
1N4748A
S102
ON-OFF
YEL
BRN
HEAT SINK
Q3
TIP41
R15
100
Q4
MPSU05
R14
1K
S133-1
P133-1
GRY
CR8
CR11
CR9
CR10
R13
470
1/2W
IC 2
723
S101
115V
RED
F101
3/4 AMP SB
RED
230V
GRY
S133-3
P133-3
C4
1000
35V
R12
3.3K
1/2W
CR12
1N4748A
F102
YEL
3/4 AMP SB
ORG
HEAT SINK
Q5
TIP41
R30
100
Q6
TIP41
R24
470
1/2W
R28
100
Q7
MPSU05
R27
1K
S134-2
P134-2
GRN
CR15
MR502
CR18
MR502
CR16
MR502
CR17
MR502
IC 3
723
R25
2.49K
1%
R26
4.99K
1%
S134-1
P134-1
GRN
R23
1.5K
C7
4700
16V
CR19
1N4748A

POWER SUPPLY SUBASSEMBLY SCHEMATIC DIAGRAM PS BOARD 13 (MOOG)

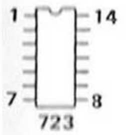
CEMENT PARTS
8 FOR THE PART
?TION OF EACH
TOR.
PECIFIED –
N OHMS 1/4W,

D (uf).
k
SUPPLIES ARE

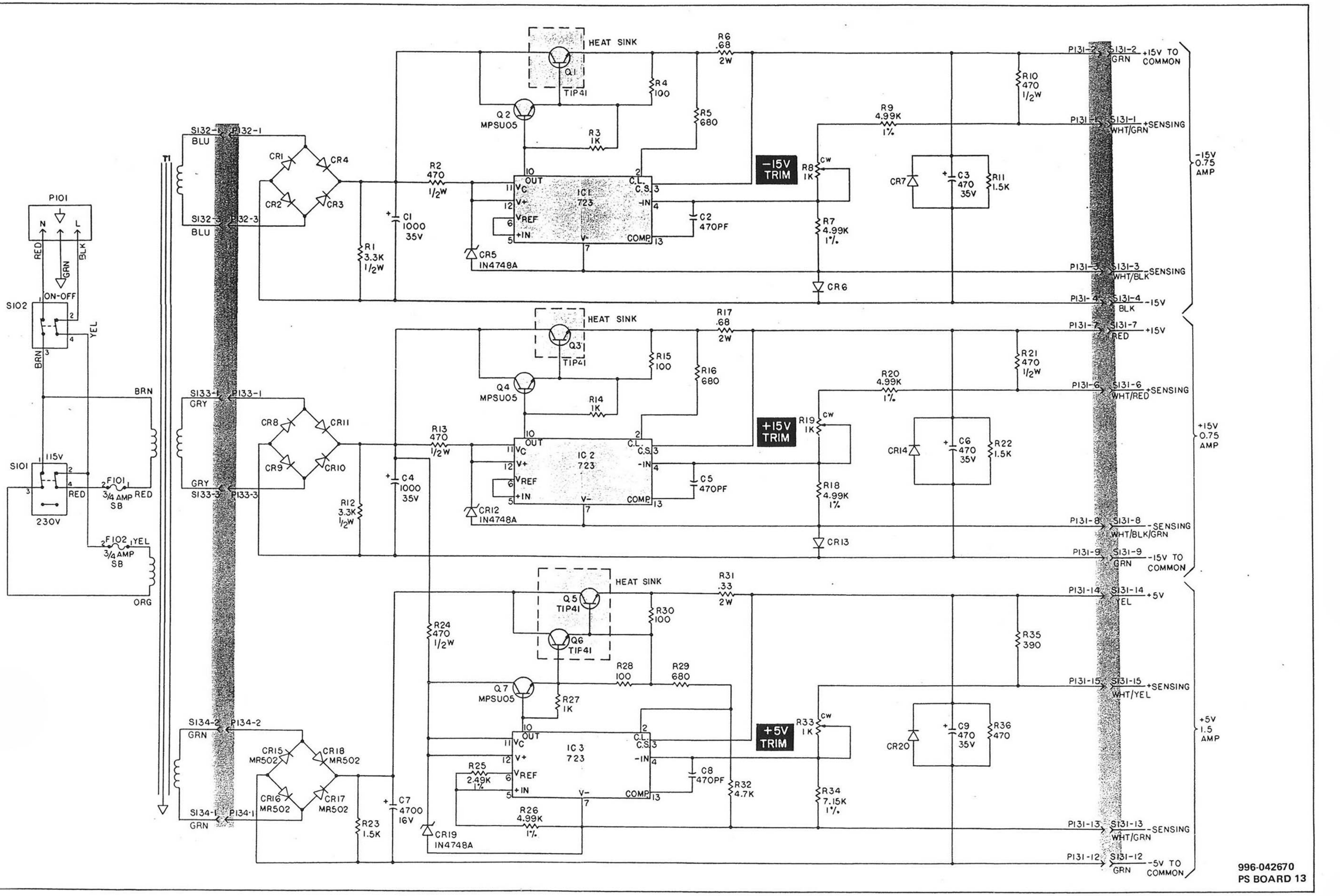
12 AND 13
REEN AND
ES.)
ARE OUTPUT

LL VARY FROM
. INDICATE IF
CTIONING.
131 ARE FIRMLY

ING



	EO
	0551
18, R19	0635
	0750
), 134-3	1157



P101
N
L
RED
GRN
BLK
S102
ON-OFF
BRN
YEL
S101
115V
230V
RED
F101
3/4 AMP SB
F102
ORG
T1
S132-1
P132-1
BLU
S132-3
P132-3
CR1
CR2
CR3
CR4
R1 3.3K 1/2W
+ C1 1000 35V
R2 470 1/2W
HEAT SINK
Q1 TIP41
Q2 MPSU05
R3 1K
R4 100
R5 680
R6 .68 2W
IC1 723
OUT
VC
V+
VREF
+IN
V-
C.L.
C.S.
-IN
COMP
CR5 IN4748A
C2 470PF
-15V TRIM
R8 1K
CW
R7 4.99K 1%
CR6
R9 4.99K 1%
R10 470 1/2W
CR7
C3 470 35V
R11 1.5K
P131-2
S131-2 GRN +15V TO COMMON
P131-1
S131-1 WHT/GRN +SENSING
P131-3
S131-3 WHT/BLK SENSING
P131-4
S131-4 BLK -15V
-15V 0.75 AMP
S133-1
P133-1
GRY
S133-3
P133-3
CR8
CR9
CR10
CR11
R12 3.3K 1/2W
C4 1000 35V
R13 470 1/2W
Q3 TIP41
Q4 MPSU05
R14 1K
R15 100
R16 680
R17 .68 2W
IC 2 723
CR12 IN4748A
C5 470PF
+15V TRIM
R19 1K
R18 4.99K 1%
CR13
R20 4.99K 1%
R21 470 1/2W
CR14
C6 470 35V
R22 1.5K
P131-7
S131-7 RED +15V
P131-6
S131-6 WHT/RED +SENSING
P131-8
S131-8 WHT/BLK/GRN -SENSING
P131-9
S131-9 GRN -15V TO COMMON
+15V 0.75 AMP
S134-2
P134-2
GRN
S134-1
P134-1
CR15 MR502
CR16 MR502
CR17 MR502
CR18 MR502
R23 1.5K
C7 4700 16V
R24 470 1/2W
Q5 TIP41
Q6 TIP41
Q7 MPSU05
R27 1K
R28 100
R29 680
R30 100
R31 .33 2W
IC 3 723
R25 2.49K 1%
R26 4.99K 1%
CR19 IN4748A
C8 470PF
R32 4.7K
+5V TRIM
R33 1K
R34 7.15K 1%
R35 390
CR20
C9 470 35V
R36 470
P131-14
S131-14 YEL +5V
P131-15
S131-15 WHT/YEL +SENSING
P131-13
S131-13 WHT/GRN -SENSING
P131-12
S131-12 GRN -5V TO COMMON
+5V 1.5 AMP

996-042670
PS BOARD 13

This manual scanned and distributed free of charge by and for the benefit of Polymoog enthusiasts.
Not to be sold, auctioned, or otherwise used to rip people off.